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MACHINERY

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The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS AND MEETINGS

DEPARTMENTS

By LORING F. OVERMAN

The Government Starts Plans for Permanent Machine Tool Reservoir

THE Production Policy Advisory Commission, set up to insure the build-up of an adequate pool of machine tools between wars so that the manufacture of war materiel can be started without delay in the event of a national emergency, has held its first meeting at the Pentagon. Press comments were to the effect that the new Commission would start "with two strikes against it." These were the inability of both the Munitions Board and the National Security Resources Board to accomplish a similar assignment to the satisfaction of all concerned.

Originator of the commission idea was Clay P. Bedford, formerly special assistant to Defense Secretary Robert A. Lovett, and production advisor to Charles E. Wilson—when the latter headed the Office of Defense Mobilization. Thus, being physically divorced from the military, the Commission might be expected to function with considerable independence. The first meeting of the Commission left the impression that Pentagon influence would again dominate, just as it had in the case of the Munitions Board and NSRB.

OVERNIGHT the Commission apparently lost its new name and gained a new home. Acting Director of the Office of Defense Mobilization John R. Steelman issued Defense Mobilization Order 15, "Establishing an Advisory Committee on Production Equipment." DMO-15 says, in part: "In order to implement and coordinate the actions of the mobilization agencies with respect to machine tool and production equipment programs . . .

"1. There is established in the Office of Defense Mobilization an Advisory Committee on Production Equipment which shall consist of a chairman and other members designated by the Director.

"2. The Committee shall review Federal policies and programs with respect to machine tools and production equipment and shall make recommendations to the Director concerning the establishment of such additional policies and programs as may be required to assure (a) the availability of machine tools and production equipment to meet defense production requirements; (b) the maintenance of adequate capacity to produce machine tools and production equipment as part of the mobilization base; and (c) the maintenance of stand-by machine tools and production equipment, including methods of modernization, rotation, or disposition of obsolete tools and equipment, to meet full mobilization needs."

The Committee is directed to report to the Director periodically and Federal agencies concerned with the subject matter of the order are required to cooperate "to the fullest extent in order to assist in carrying out the work of the Committee."

THE new assignment pins the Committee down to the machine tool and production equipment problem specifically, whereas the name its sponsors initially picked suggests that they may have contemplated going far afield in determination of "policy." Instead, the Office of Defense Mobilization has issued Defense Mobilization Order 16, which names a new Inter-agency Committee on Production Policy.

The inter-agency committee is to consist of the Defense Production Administrator as chairman, and a representative from each of eleven departments and agencies. Represented on the Committee will be the Departments of Defense, Interior, Commerce, Agriculture, and Labor; the Defense Production Administration, Defense Materials Procurement Agency, Atomic Energy Commission, Defense Transport Administration, Economic Stabilization Agency, and National Security Resources Board.

Just to make certain the new inter-agency group is understood by all to be "top dog," Defense Mobilization Order 13 was amended May 20 to require that the name of the ODM Procurement Policy Board (established January 3, 1952) be changed to the Defense Procurement Policy Committee, and designated as a sub-committee to the ODM Committee on Production Policy.

So, instead of being a policy-making body, the promised machine tool commission turns out to be merely an advisory group. Perhaps it is better that way. It leaves a couple of loopholes, just in case all of the ideas don't work out as planned.

MEANWHILE a recent survey of manpower in 181 machine tool plants disclosed a continuing need for skilled and semi-skilled machine tool workers, tool designers, machinists, and other skilled workers essential to defense production. Applicants being sought through out-of-area recruitment include engine lathe operators, hand scrapers, toolmakers, milling machine operators, planer operators, and turret lathe operators.

THE Defense Production Administration has announced that it is planning to set machine-tool expansion goals soon. In the meantime, applications for tax amortization certificates are being approved as rapidly as possible. Feasibly one of the first assignments of the new Advisory Committee on Production Equipment will be to work with NPA in projecting the industry's needs for future years.

As of mid-May, a team of "specialists" (accompanied by "a contracting officer with authority to place orders") was in Europe studying the possibility of procuring huge castings for the Air Force heavy press program. The team carries drawings for sixty-nine separate castings ranging from 50 to 150 tons. Eight forging presses are to be built, ranging in size from 25,000 to 50,000 tons (applied pressure), and nine large extrusion presses.

Production Efficiency Deserves Reward in Renegotiation

ANY manufacturing concern that fills defense contracts with outstanding efficiency or makes an unusual contribution to the defense effort deserves special consideration in renegotiation proceedings. That rewards can be anticipated for such enterprise on the part of manufacturers was implied in a recent address made by John T. Koehler, chairman of the Renegotiation Board. Such contractors will probably be permitted to retain a profit much higher, when expressed in percentage of sales, than other companies in the same industry that did not make similar contributions to the defense effort.

Six points were cited by Mr. Koehler as being fundamental in any approach to renegotiation problems, as follows:

1. Statutory renegotiation has no place in our competitive system during any period in which that system is not affected by partial or total mobilization or by controls which do not exist in a normal, peacetime economy.

2. American industry should recognize that, in times like these, it is essential that the Government provide machinery by which excessive profits may be returned to the Government in order to remove any basis for charges that industry is making more than a reasonable profit from its participation in the defense effort.

3. Renegotiation is primarily an instrument of price and cost control, and should not be viewed as a taxing statute.

4. Renegotiation should reach its end result—the determination of excessive profits—by the exercise of disciplined judgment.

5. Renegotiation must be administered fairly, in a manner designed to give equal treatment to every contractor.

6. Renegotiation must discharge its responsibilities by imposing the lightest possible burden on American industry. Manpower and money spent on Government reports, forms, and conferences are manpower and money that will not be converted to production.

These basic thoughts seem to provide a foundation for fair, impartial rulings in renegotiation proceedings, and forecast far more amicable relations between businessmen and Government renegotiators than in the World War II period. The plan is to keep businessmen fully informed concerning procedures to be followed in renegotiation activities, and these procedures are to be kept as simple as possible. All businessmen are to be treated alike.

Criticisms have been made that renegotiation has always been a formula affair, that no matter what substantial differences might have existed among companies with respect to their efficiency, the amount of risk assumed by the companies, or their contributions to the defense effort, the profit which they were permitted to retain after renegotiation was always determined on the basis of a percentage of their sales.

The announcement of the procedure to be followed in the future will be received with acclaim by industry because when a manufacturing concern exerts extraordinary efforts to achieve production records for the welfare of the nation, commendation and material rewards have certainly been earned.

Charles O. Herb

EDITOR

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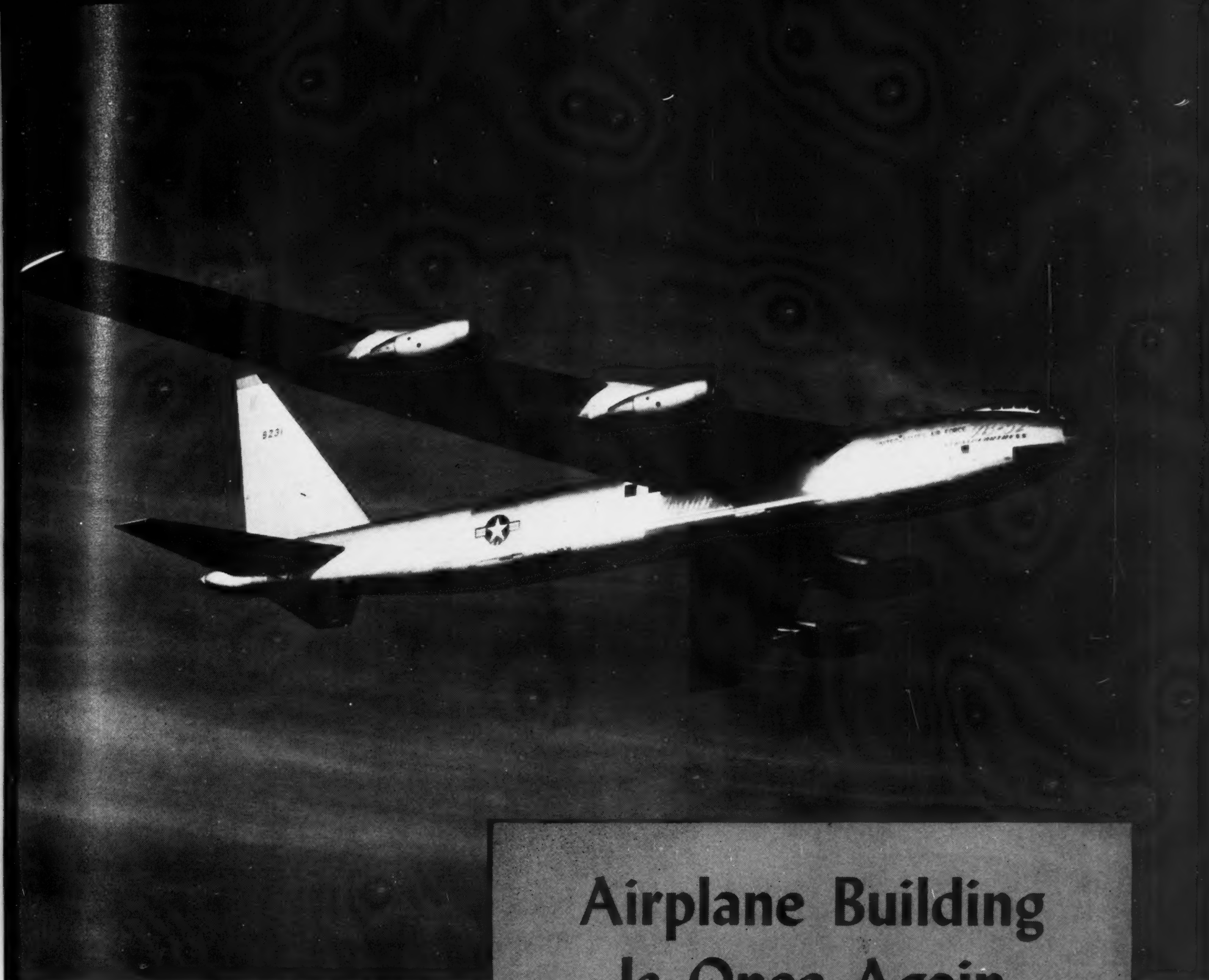

Boeing YB-52 Stratofortress

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AIRCRAFT
PRODUCTION
NUMBER

MACHINERY
July, 1952
Vol. 58 No. 11

Airplane Building Is Once Again A Big Business

Employment in the aircraft and aircraft parts industries this year will average 600,000 employes. When this figure is compared with an average employment of 713,500 workers for automotive and automotive accessories plants in 1950, it becomes apparent that aircraft building is once more being carried out on a large scale.

An ever-present problem in the aircraft industry is the necessity of developing manufacturing methods to meet new conceptions of aircraft design. The widespread adoption of jet engines since World War II required an extensive change-over of machines and methods in both engine and airframe plants. The substitution of integral-ribbed skin panels for riveted and welded structures brought a number of perplexing problems. These and many other problems have been solved through the ingenuity of tool engineers and production men. Some of their achievements during the past year are here described in MACHINERY'S Twelfth Annual Aircraft Production Number.

The High-Speed Airplanes

Skins of Glass-Plastic Laminates and Airframes of Honeycombed Stainless Steel Must be Developed Along with New Fuels for the 2000-Mile-Per-Hour Airplane

By THOMAS E. PIPER
Chief Process Engineer
Northrop Aircraft, Inc.
Hawthorne, Calif.

THE artist's conception of the airplane of the future has glass wings, glass ailerons, glass stabilizers, and an all-glass fuselage. It is fastened with glass rivets and supported by titanium and stainless-steel light-weight structural members. With a fuel having a lower vapor pressure than any fuel in use, and with an engine lubricant consisting of a dry heat-resisting powder, its power plant will thrust it through the air at better than 2000 miles per hour. It can be more easily fabricated, and in fewer man-hours, than contemporary military or commercial aircraft.

Military fighters now in production, such as the F-89 Scorpion built by Northrop Aircraft, Inc., Hawthorne, Calif., have maximum speeds approaching or surpassing acoustic velocity. But if aircraft are to fly successfully at two and three times acoustic velocity, they must first of all be designed to negotiate the so-called "heat barrier" that drastically lowers the mechanical properties of aluminum and magnesium alloys at such extreme speeds.

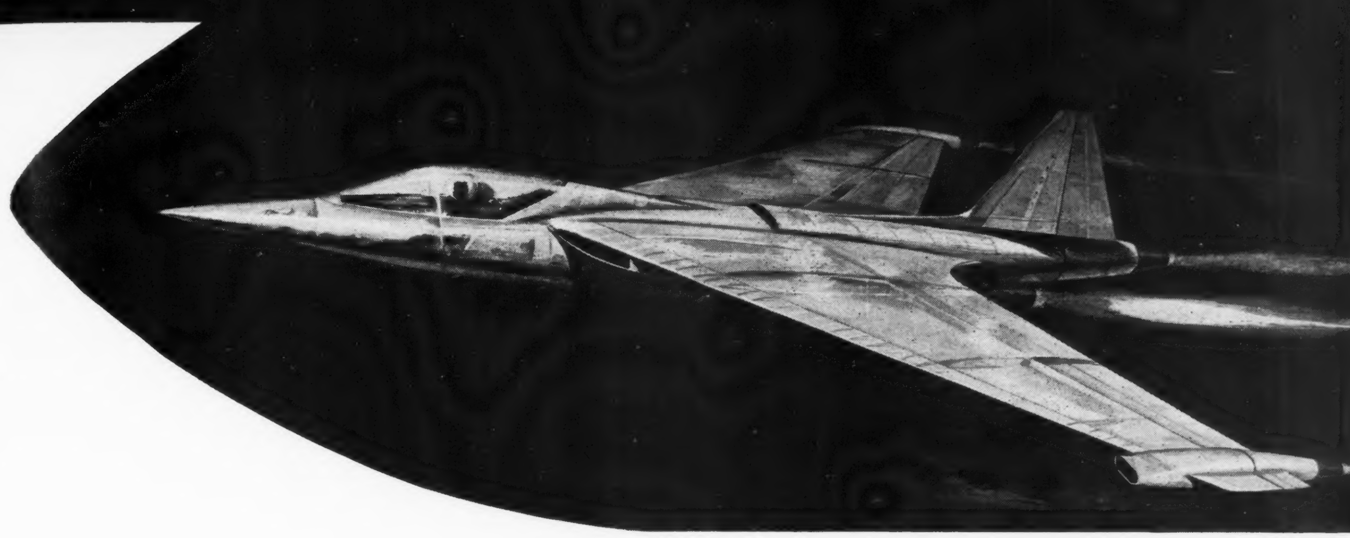
The heat barrier for high-speed aircraft can be attributed to the ram-compression temperature rise on the skin surface over which the air passes. This temperature increase is the result of a transformation of the kinetic energy of the moving body into heat energy, and rises in direct proportion to the square of the velocity. Thus, as the speed of an airplane is doubled, the ram-compression temperature rise on the skin surface is increased fourfold.

Flight altitude also is a factor, since with the decrease in the speed of sound from 760 miles per hour at sea level to 675 miles per hour at 30,000 feet, there is a corresponding ram-compression temperature rise for these speeds ranging from 70 to 90 degrees F. In order to determine the maximum temperature to which the localized high-friction areas on the surface of a plane flying at a given speed might be exposed, the ram-compression temperature rise for that speed must be added to the ambient temperature in which the plane is flying.

On the standard United States Air Force Summer Day, the temperature at sea level is taken at 100 degrees F. In the graph in Fig. 1 the temperature can be seen to decrease with an increase in altitude up to 46,500 feet, after which the temperature is assumed to remain constant. The kinetic temperature increase for a speed of 760 miles per hour is about 88 degrees F., so the maximum surface temperature to be expected on a plane flying at that speed is about 188 degrees F. This is one of the reasons why it is necessary to cool the interior of an aircraft like the F-89 in order to maintain comfortable conditions for the occupants. Special refrigerating equipment must be installed in the plane for this purpose.

Ram-compression temperature rises encountered in the transonic range (500 to 800 miles per hour) have not proved excessive for the light metal alloys used in present aircraft. But as flying speeds increase, new materials will def-

of the Future



An artist's conception of an all-glass airplane, built from heat-resistant materials to withstand the searing temperatures encountered at speeds three times that of sound.

initely be required. At 1300 miles per hour the ram-compression temperature rises to about 260 degrees F., and at 2600 miles per hour it rises to slightly more than 1000 degrees F. That such temperatures are not unrealistic is indicated by the fact that German engineers recorded surface temperatures exceeding 1500 degrees F. for their V-2 rocket. It has been calculated that the average meteor entering the earth's atmosphere at a speed of 20 miles per second creates a ram-compression temperature of more than 5400 degrees F.

Fig. 2 shows the relation between surface temperature and air speed at various altitudes on a USAF Summer Day. For the purpose of this graph, it is assumed that the ram-compression temperature rise for a given air speed is constant at all altitudes. Points plotted on each curve were determined by adding the kinetic temperature increase for the given air speed to the ambient temperature at that altitude.

In view of the drastic reduction in the mechanical properties of commonly used aluminum and magnesium alloys above 300 degrees F., it can be realized from the speed-temperature curves in Fig. 2 that new alloys of these materials, or entirely new materials, will have to be used to fabricate the high-speed airplanes of the future. For example, at room temperature the tensile strength of the best heat-resistant aluminum alloy (24S-T) is 62,000 pounds per square inch. After one hundred hours at 500 degrees F., the strength of 24S-T drops to 18,000 pounds per square inch. In other words, the strength of this alloy at 500 degrees F. is about 30 per cent of its value at room temperature. And for 75S-T aluminum alloy—a great deal of which is used in the F-89—this loss amounts to approximately 80 per cent.

Both the Dow Chemical Co. and the Aluminum Co. of America are known to be working vigorously to overcome the limitations of their products in this respect. Recent Dow experiments with alloys of magnesium and the rare-earth elements indicate that these alloys may maintain good tensile properties at temperatures well in excess of 300 degrees F. Alcoa's search for an adequate substitute for 24S-T is also reported to have met with some success.

At present, glass-plastic laminates appear to offer considerable promise of giving good service at high speeds. For use in future aircraft, woven glass fabric can be laminated with temperature-resistant materials such as phenolic resins or silicones. The resulting structure has a favorable strength-weight ratio and maintains a high percentage of its strength around 500 degrees F. For example, phenolic-resin impreg-

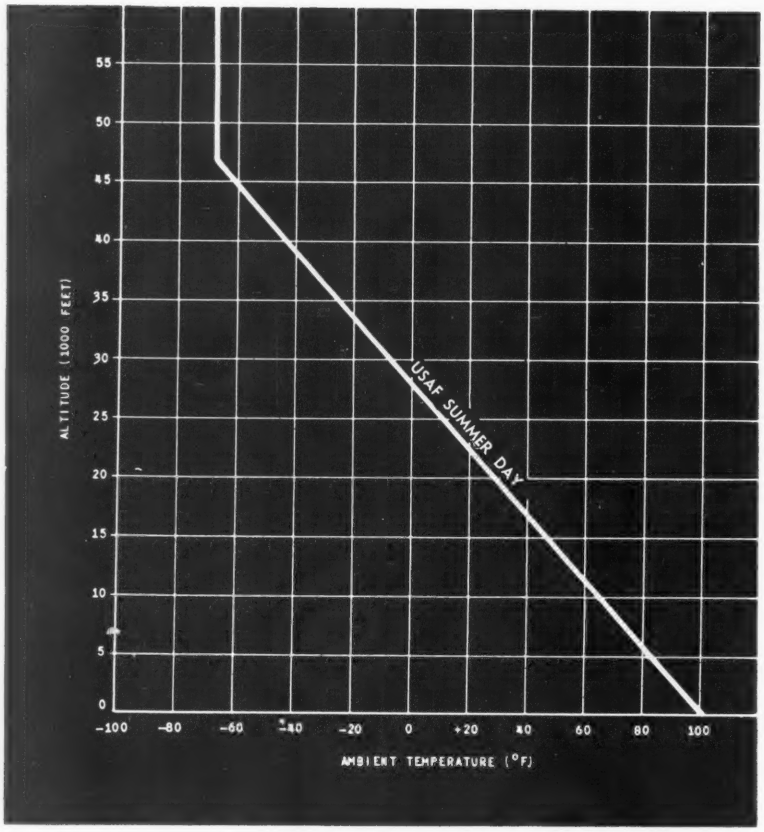


Fig. 1. Temperature of the ambient atmosphere at various altitudes on the standard United States Air Force Summer Day

nated glass-fabric laminate having a tensile strength of 80,000 pounds per square inch at room temperature experiences little or no loss in mechanical properties at 300 degrees F., and maintains a strength of 35,000 pounds per square inch after an exposure of one hundred hours at 500 degrees F.

An outstanding advantage of this molded material is that it has a lower coefficient of expansion than a metal structure. This means that localized dimensional changes produced by differential exposure to heat will be less severe than in metal aircraft. Because of the low heat-transfer properties of the laminate and the fact that it is integrated with like materials having the same coefficient of expansion, there will be less structural warpage and little danger of other aero-elastic variations that could damage the airplane and establish highly critical problems of control.

Although flexibility may be somewhat greater with glass-plastic materials than with metals, the designer can often make favorable use of this property. Moreover, simplified tooling will greatly lower production costs. It is conceivable that an entire airframe of glass-plastic laminate could be produced in four or five basic molds, with only a handful of skilled personnel. Increased aerodynamic smoothness would be achieved by the elimination of many skin joints, rivets, and screws. Then too, all surfaces produced from the same mold would have precisely the same configuration.

British airframe manufacturers have fabricated a set of glass wings which will be flight-tested in about six months. American manufacturers believe that extensive structural use can be made of glass-plastic materials, and that a complete military combat type airframe designed specifically for glass-plastic materials and manufacturing methods is entirely within the realm of possibility. The cost of designing and producing a full-size airframe from glass-plastic should not be proportionately greater than for a smaller size model.

Recent developments in the phenolic-resin field give promise of plastic laminates with improved properties. If these materials retain the essential physical and mechanical properties at elevated temperatures, aircraft capable of withstanding the skin friction encountered above sonic speed will be a reality in the near future. This means that for the present a vigorous all-out program of research must be pressed forward. New materials must be developed. New processes must be contrived. Many tests must be run. For example, shown in Fig. 3 is a "hot box" specially designed for tensile tests at elevated temperatures. In the box is a test coupon of a glass-fabric laminate.

Next to the glass-plastics among new material possibilities is titanium. Despite some disap-

pointment for those who were too swift to proclaim it the "glamour metal," titanium is now gaining sound stature as the "middle-weight champion." Its importance as a load-carrying member in future airframes seems unquestionable. Titanium's admirable strength-weight ratio and its ability to withstand corrosive attacks at high temperatures are well known. Titanium alloys offer good heat resistance.

Another advantage of titanium is its exceptional strength when exposed to dynamic fatigue factors, such as the simultaneous exposure of a structural member to the resonance of high-powered engines, and to the effects of high-velocity air currents. Titanium also has the ability to resist dynamic creep, that is, the creeping of a metal under co-existing stresses—such as the simultaneous exposure of a structural member to tension and compression, or to tension and torsion.

It seems likely that the high initial cost of titanium will soon be lowered. At present the cost of titanium alloys delivered in reasonable quantities is about $20 per pound. At least one authority believes that this will be reduced to $6 per pound within the next two years. Titanium is the fourth most abundant structural metal in the earth's crust; rich, workable ore deposits have recently been discovered both in the United States and Canada.

The glass rivets in the plastic structures of the high-speed airplanes of the future are still farther away than just around the corner. If research in this field is eventually successful, the rivets will probably consist of glass roving having uni-directional fibers impregnated with silicones or phenolic-resins. They would presumably exhibit superior fatigue strength because of the resilience of the material. More important, during exposure to elevated temperatures there would be no differential expansion between the fastener and material being joined. One of the experimental glass rivets is shown in Fig. 4. However, tests of these rivets have already disclosed the need for further refinement in their design.

A more realistic possibility is the early development of a titanium version of the removable blind fasteners shown in Fig. 5. This new joining device may save up to 200 per cent in production time and 30 per cent in design time. It may be substituted for AN (Air Force-Navy) bolts and nuts, where strength requirements are satisfactorily fulfilled.

It is true that low-speed aircraft of stainless steel have been successfully built and flown; but weight, of course, remains the great drawback to the widespread use of present forms of steel in high-speed airplanes. Before stainless steel or alloys of titanium can be used successfully in

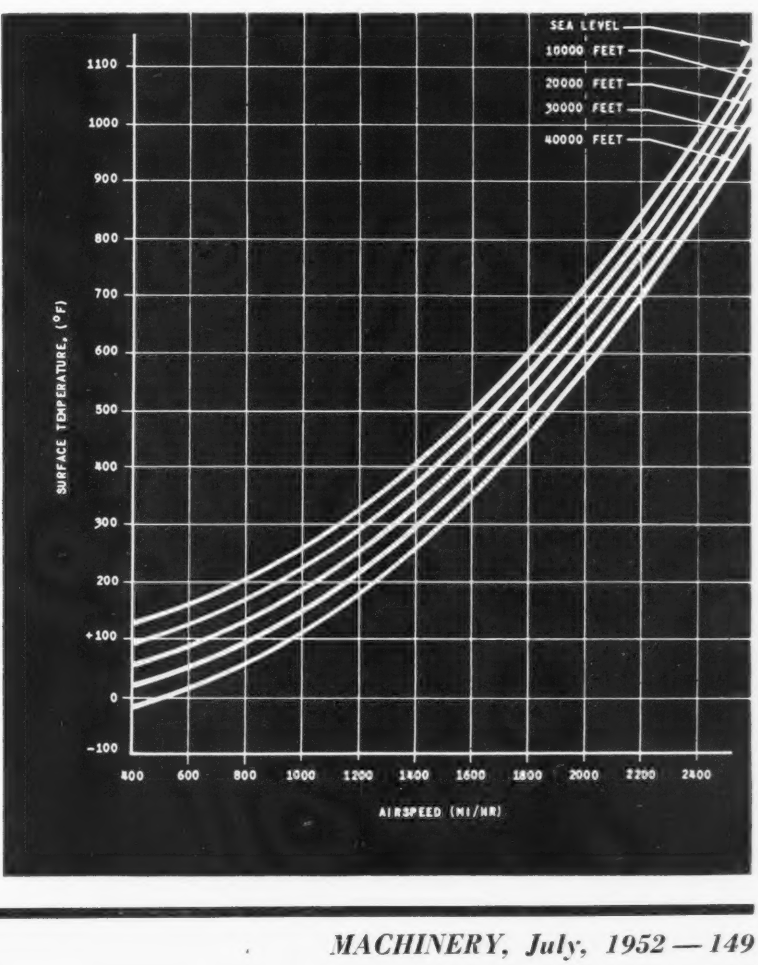


Fig. 2. Ram-compression temperature rise shown graphically in relation to air speed at five altitudes

Fig. 3. "Hot box" specially designed for tensile tests performed at elevated temperatures

high-speed aircraft, research must first produce low-density forms of these metals. Stainless steel honeycomb, which is now being experimentally produced by several American companies, seems to offer considerable promise. This is a light-weight core material that combines great heat resistance with high rigidity. More than 80 per cent of the volume of a honeycomb structure consists of its hexagonal air spaces.

However, under the high-temperature conditions postulated in this article, a severe limitation to the application of honeycomb construction is the lack of adequate means of bonding the elements to the skin or metal sheets composing the sandwich faces. Organic adhesives presently used for this purpose possess very poor heat-resisting characteristics. Even now, design requirements are far in excess of the capabilities of such adhesives, so it seems that some other bonding method will have to be developed. Improved welding, soldering, or brazing techniques should receive special attention in this regard.

Steel in one form or another will undoubtedly play an important role. Castings of steel proved their service reliability in the fighter planes of World War II. Better foundry practice is needed for making large, light-weight, thin castings (0.100 inch thick) that have draft angles of less than 1 degree. In the search for light-weight, high-strength steel forms, attention should be given to new corrugating methods and improved diamond punching.

Fuels and lubricants must also change radically to meet the new conditions of speed and heat. At two and three times the speed of sound, it will be necessary to find means of preventing hydrocarbon engine fuel from boiling. Various methods of refrigerating the fuel tanks have been suggested. There is a need for a readily available fuel having vapor pressure sufficiently low to resist boiling away at the temperature produced in the fuel system by the ram-compression temperature increase.

Future high-temperature lubricants will prob-

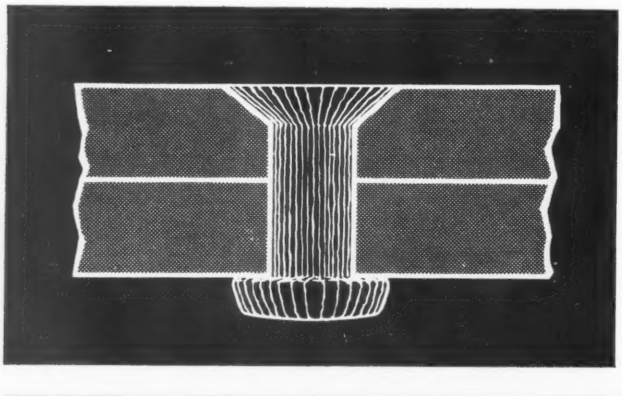
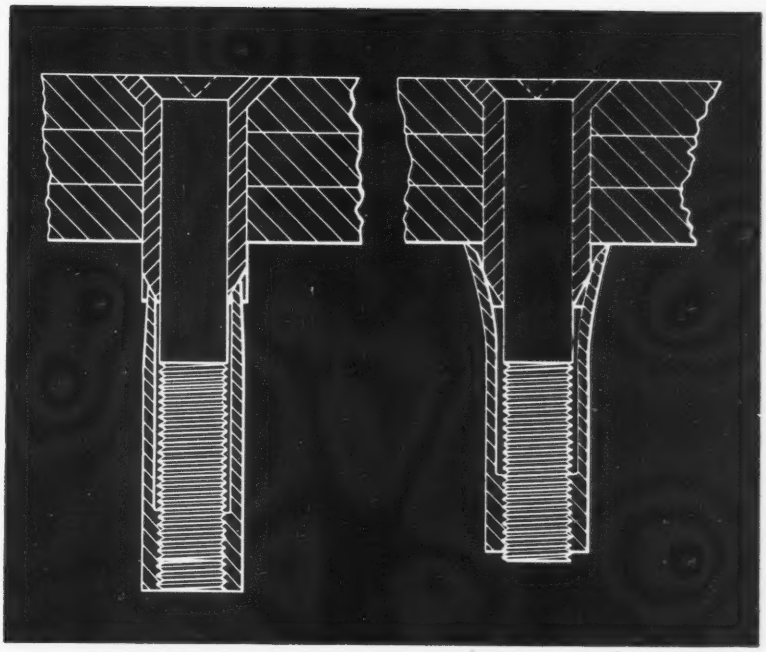


Fig. 4. Using a glass-plastic rivet such as this will prevent differential expansion between the body and the fastener.

Fig. 5. Removable flush blind fastener, shown in inserting position at left and clinched position at right



ably be of the metallic dry-powder or dry-film type, such as molybdenum disulphide, with or without a carrier. Wet lubricants developed to give service in the range of 350 to 700 degrees F. will probably be unsatisfactory for extreme low-temperature operation; they may also exhibit rather poor lubricity, or have undesirable toxic or corrosive properties.

The methacrylate plastic now used in the canopy enclosing the cockpit of military aircraft will have to be changed to silicate glass. New heat-resisting rubber-like materials will have to be developed for all sealing applications. Smoother surface finishes—smoother even than the finish on a grand piano—must also be obtained.

The materials evolution necessary to implement production of the kind of airplane shown in the heading illustration will be accomplished only through a carefully planned program of research and development. Achieving the new material forms will be a more complex matter than "pouring old wine into new bottles." It will take time, money, and above all, work. But the benefits of the program will not redound to the benefit of the airframe companies alone. Industries that will find application for the new products may be numbered by the score. There is scarcely a manufacturer in the United States who will not experience in his own business the impact of this evolution.

A Revolutionary Boeing Helical Carbide Milling

Boeing B-47
Stratojet Bomber

By
ALLEN STOVER, Foreman, Carbide Development;
R. W. COOPER, General Foreman, Department 111; and
W. L. FRANCE, Assistant Superintendent of the Fabrication Division
Boeing Airplane Co., Seattle, Wash.

IN the aircraft industry, it is mandatory to machine work to exceptionally fine finishes and close dimensional tolerances. Obtaining these objectives on an economical basis becomes a major problem whenever new jobs must be tooled. Carbide tools have been extensively used for this purpose since pre-war days for turning, boring, and face-milling of aircraft components. During the last three years, tool designers of the Boeing Airplane Co., Seattle, Wash., have proceeded a step further after a great deal of experimentation and have developed helical carbide milling cutters, which are now being used for a variety of work. Over 300 cutters of this type are being applied in production operations.

These helical carbide milling cutters are normally used at three times the speed of the cutters they have replaced. In addition to faster cutting speeds, an important advantage of this type of carbide cutter over straight-blade milling cutters is the reduction of any tendency of the carbide blades to chatter or crumble under impact—one of the chief causes of carbide cutter failure. The removal of this tendency is due to the uniform distribution of chip load obtained with helical blades.

Machine finishes of 20 r. m. s. and better have been readily obtained on S A E 4340 steel heat-treated to give a tensile strength of 180,000 to 200,000 pounds per square inch. On 75S aluminum alloy, cutter speeds up to 200 surface feet per minute have been possible in slab-milling spars 4 3/4 inches wide, the depth of cut being 1/16 inch. The feed is 280 inches per minute and the 7-inch diameter cutter revolves at 3550 R. P. M. The cutter is provided with four carbide blades, each 6 inches long. A close-up view of this spar mill set-up is shown in Fig. 1. The finish obtained in this operation is also 20 r. m. s. or better.

A cutter with two helical blades has also been made for spar-milling. On this cutter, which is shown in Fig. 3, the front faces of the blades were superfinished to provide exceptionally keen cutting edges and to facilitate discharge of the rapidly formed chips. This cutter is likewise run at 3550 R. P. M. The load on both the four-blade and two-blade spar-milling cutter is a chip 0.015 inch thick.

The design of the body for the four-blade cutter is shown in Fig. 2, the pockets for the carbide blades and the flutes being inclined at an

Development–Cutters

angle of 20 degrees relative to the cutter center line. Carbide blades 3/32 inch thick are used, and they project 1/16 inch beyond the periphery of the body. The face of each blade is set 0.919 inch in back of and parallel to a line drawn through the center of the body, which results in a positive hook rake of 15 degrees on the face of the blade. All cylindrical surfaces of the cutter body must be concentric within 0.001 inch and square with ground faces within the same tolerance.

Helix angles from 15 to 20 degrees are normally provided on all helical carbide milling cutters. The power required for a given cut decreases with an increase in the helical angle; therefore, less power is required to drive the heli-

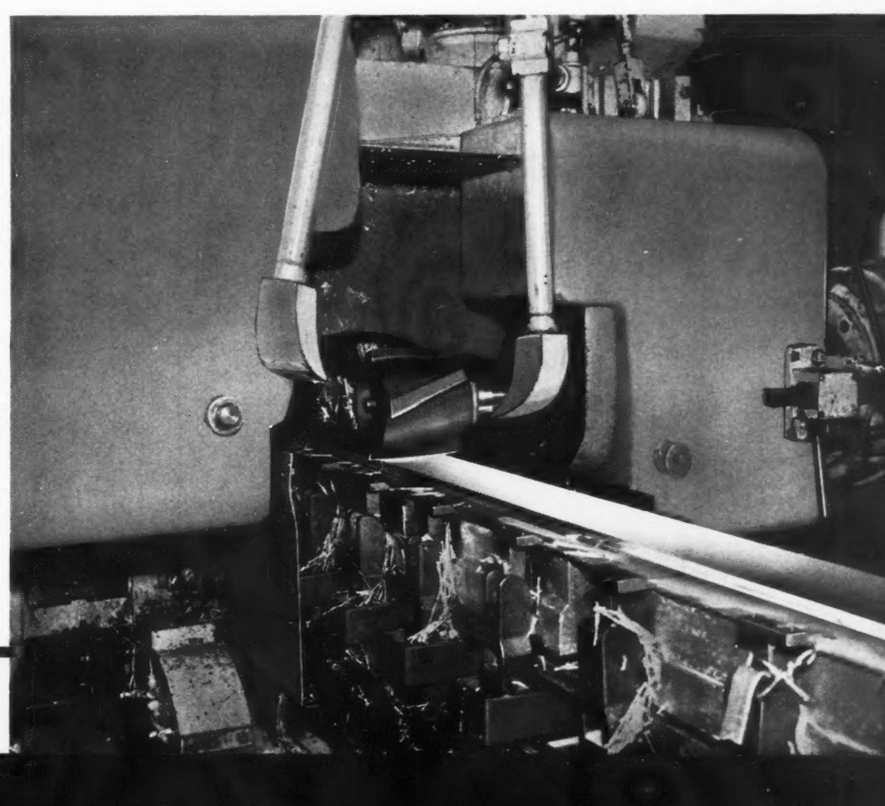


Fig. 1. Four-blade helical carbide milling cutter which runs at a surface speed of 200 feet per minute in milling 75S aluminum spars

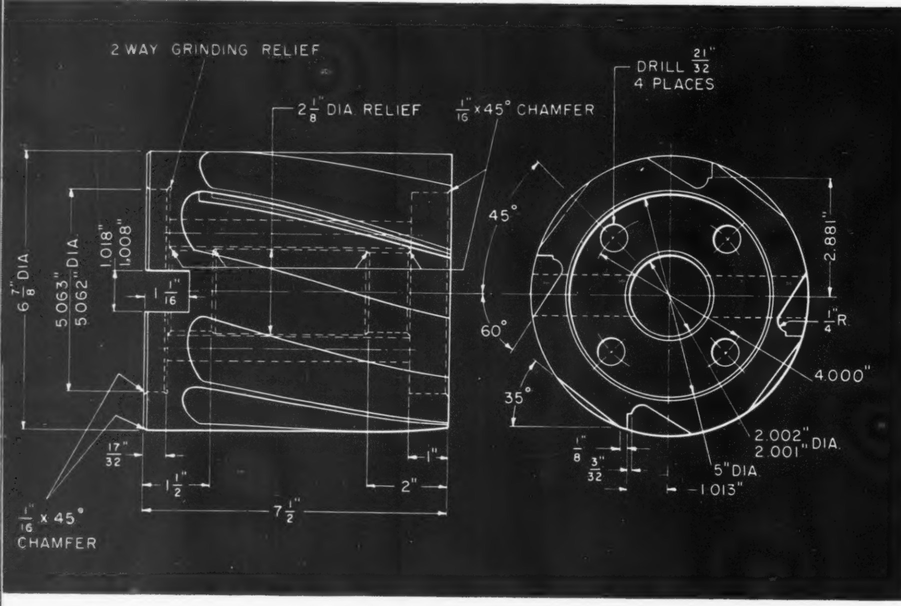


Fig. 2. Cutter body designed for the four-blade helical carbide milling cutter that is illustrated in Fig. 1

cal carbide cutters than similar straight-blade carbide cutters.

The most important problem which had to be solved in the development of helical carbide milling cutters was to devise a means of curving or twisting the carbide blades prior to installation on the bodies. Carbide blades can usually be obtained from manufacturers only in the flat or straight shape and must be individually formed to suit each cutter body although some companies are now supplying twisted carbide strips.

Twisting of the blades to suit the specified helical angle is accomplished by heating them to between 2200 and 2300 degrees F. on the General Electric electronic heater seen in Fig. 4. The carbide blade is held in a water-cooled fixture as shown. As the carbide blade is heated and becomes plastic, it is automatically twisted to the desired helix by a weight suspended from the pulley at the right.

Originally it was the practice to twist the carbide blades by means of a pair of pliers while the blades were held in a vise and heated by the application of an oxy-acetylene torch. This was, however, a slow and tedious process and quite a few blades were ruined by exceeding a temperature of 2300 degrees F. It was necessary for the operator to judge the temperature of the carbide blades by their color and, consequently, uniform practice within the desirable temperatures was impossible.

The heading illustration shows an angular surface being machined on a slab of 75S aluminum alloy by employing a conical milling cutter with helical carbide blades. The shape of the cutter may be observed in Fig. 5. In this illustration the cutter is being balanced on a Merrill machine that provides for both static and dynamic balancing. In the milling operation, the cutter is run at 1258 R. P. M. and takes a cut 3/8 inch deep at a feed of 60 inches per minute.

The development of this cutter has increased the life of cutters employed for operations of this type approximately four and a half times, and has resulted in a saving of 50 per cent in

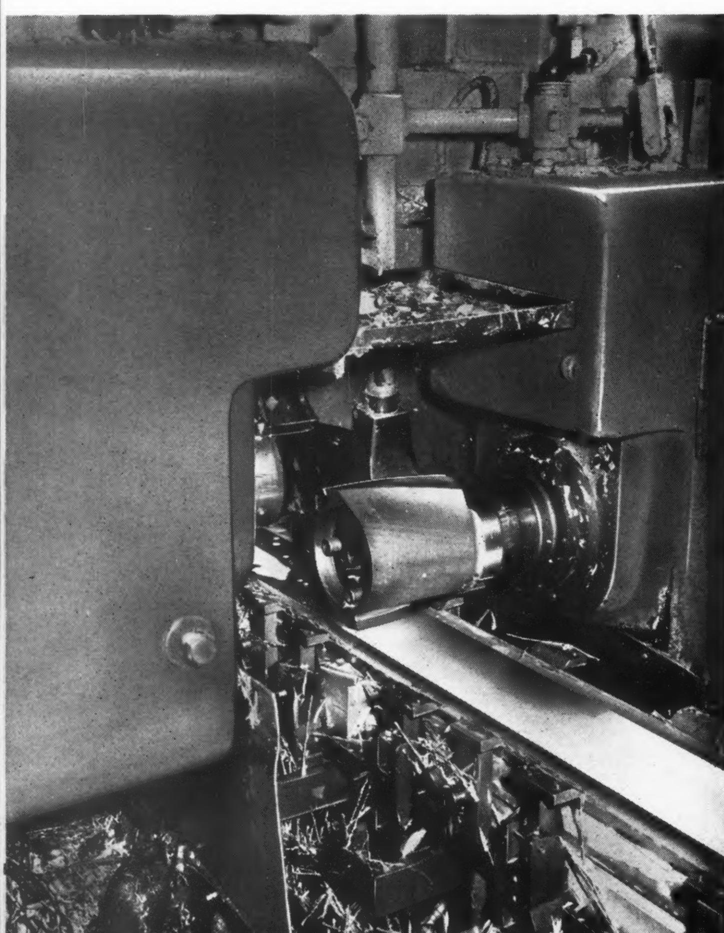


Fig. 3. Two-blade helical carbide milling cutter operated at a surface speed of 200 feet per minute in obtaining a high finish at a fast rate on 75S aluminum spars

Fig. 4. *Equipment used for heating carbide blades to between 2200 and 2300 degrees F. and automatically twisting them to the required helix*

sharpening time. In taking a maximum "bite" of 1/2 inch thickness, there is a 20 per cent saving in horsepower over the power required with straight-blade milling cutters. In addition, far less hand work is required in smoothing ridges left by the cutter. The tolerance for concentricity and squareness of body surfaces is also 0.001 inch.

At *A* in Fig. 6 is shown what is believed to be the first helical carbide cutter used in milling a heat-treated alloy steel. It is made with six flutes. This cutter has been used on S A E 4340 steel heat-treated to provide a tensile strength between 180,000 and 200,000 pounds per square inch. Stock amounting to over 600 cubic inches is removed from a contoured surface to a finish of 40 r. m. s. The cutter runs at a surface speed of 200 feet per minute, and is fed 10 inches per minute. Stock is removed to a depth of 0.100 inch per cut. The carbide blades are positioned at an angle of 20 degrees with the center line, as shown at *A* in Fig. 8.

The cutter illustrated at *B* in Fig. 6 was designed for preliminary test work in settling basic design problems for cutters intended to be used on a Cincinnati horizontal Hydro-Tel milling machine. The problem arose because the machine is run at the high spindle speed of 7000 R. P. M. and at a table feed of 80 inches per minute. The helical angle of the flutes is 10 degrees. Later, this cutter was superseded by a cutter of similar design having flutes machined to an angle of 20 degrees. With these cutters it was first determined conclusively that helical carbide milling cutters offered important advantages over the cutters previously used.

At *B* in Fig. 8 is shown a 2-inch helical end-mill, the cross-sectional views illustrating the differences in the positioning of the carbide blades when they are designed for machining steel or for machining aluminum alloys. Cross-section *X* illustrates the construction when the cutter is intended for operations on steel, while cross-section *Y* shows the construction for a cutter for aluminum alloys.

Fig. 5. *Conical helical carbide milling cutter shown here on a Merrill balancer. This machine provides for both static and dynamic balancing*

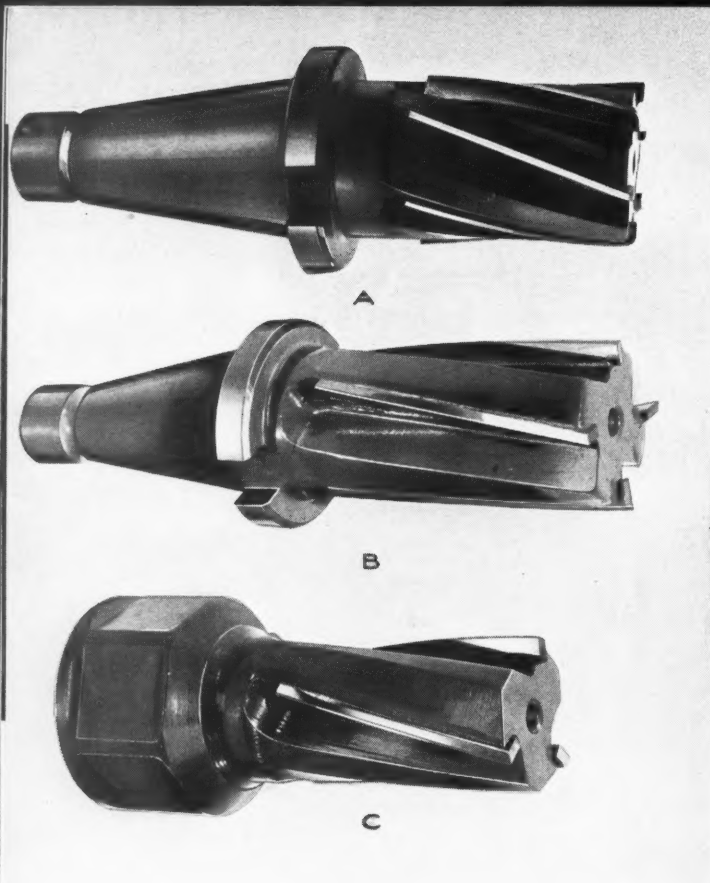


Fig. 6. Helical carbide milling cutters that have been made in a large range of sizes

A three-fluted cutter designed for machining aluminum alloys on an Onsrud spar mill is illustrated at *C* in Fig. 6 and at *C* in Fig. 8. End-mills have been made in many sizes from 1 inch to 3 inches in diameter. The smaller sizes have customarily been made with three flutes, but there have been several with only one flute. Two-flute designs are not recommended for small-diameter cutters because of the comparatively weak cross-section that would exist between the flutes. An end-mill only 1 inch in diameter with a single flute and with a rounded nose is shown at *A* in Fig. 7. The helical angle on this tool is 20 degrees and the front or hook rake 10 degrees. This tool was designed specifically for milling aluminum alloy on a Hydro-Tel horizontal milling machine.

At *B* in Fig. 7 is shown another single-flute end-mill designed for Hydro-Tel applications. This cutter is 1 1/2 inches in diameter, and has a 10-degree helical flute and a front or hook rake of 10 degrees. At *C* in Fig. 7 is shown a three-flute cutter 3/4 inch in diameter designed for routing operations. The cutter is intended primarily for cutting master form blocks from laminated plastics, Bakelite, and cast aluminum.

Surface finish and close dimensions are important factors in these operations. Hence, standard straight-flute cutters are unsatisfactory because hand operations are necessary to eliminate chatter marks and obtain the desired finish. The cutter is mounted on a vertical-spindle machine and is run at 10,000 R.P.M. The flutes are machined at an angle of 15 degrees. The carbide blades have a front or hook rake of 10 degrees. An integral stem is provided in front of the blades for mounting a roller that is em-

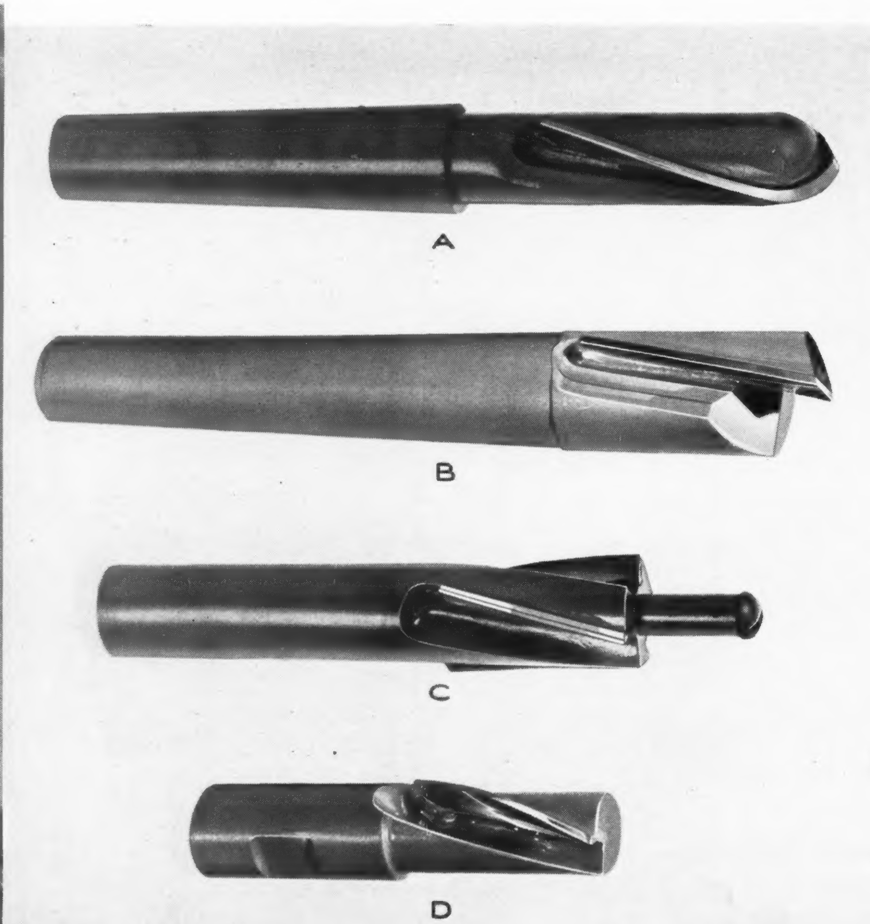


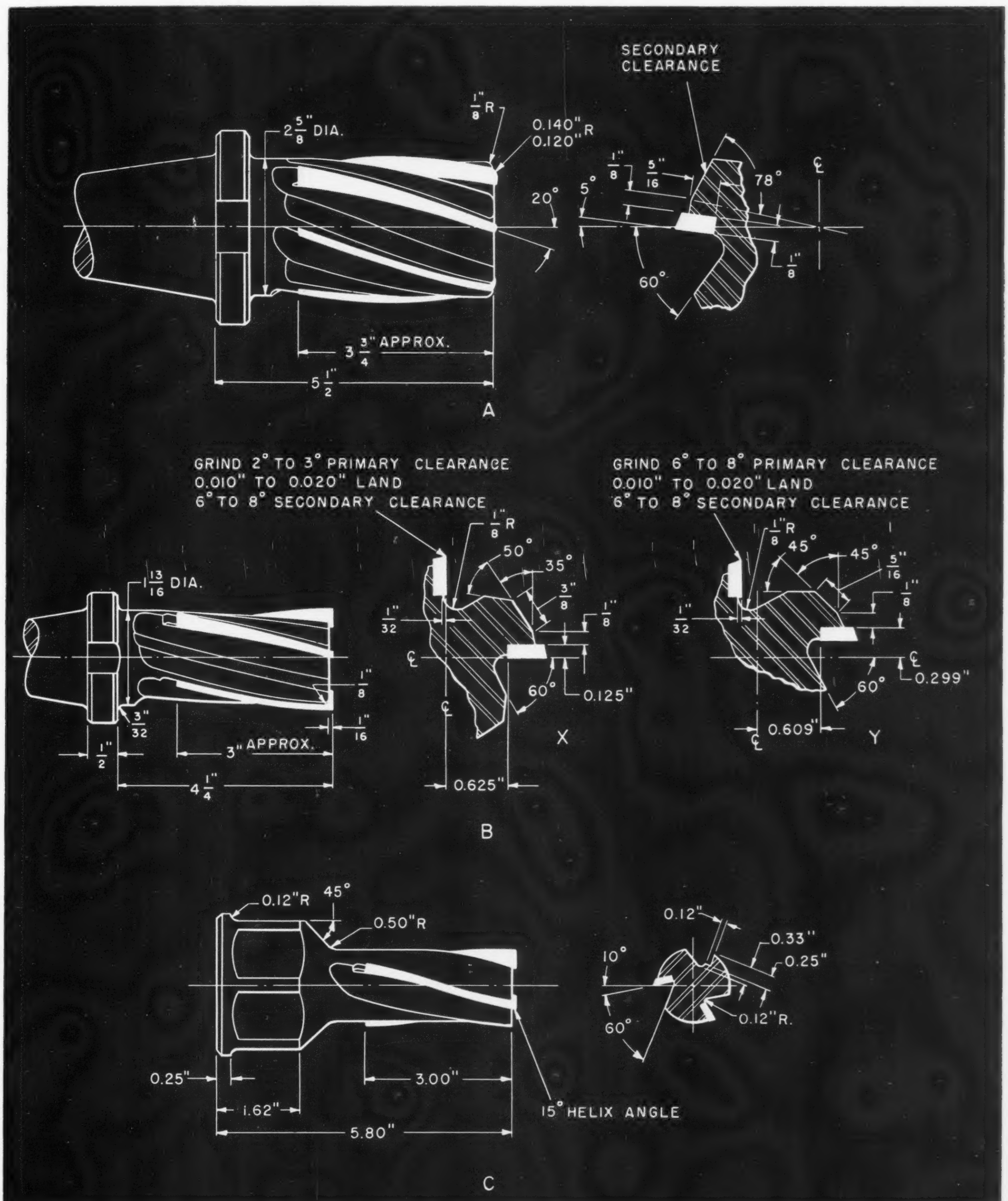
Fig. 7. Small-diameter helical carbide cutters of single- and three-flute designs which have been made in various sizes down to 0.525 inch

ployed in guiding the cutter from a template in routing the form blocks.

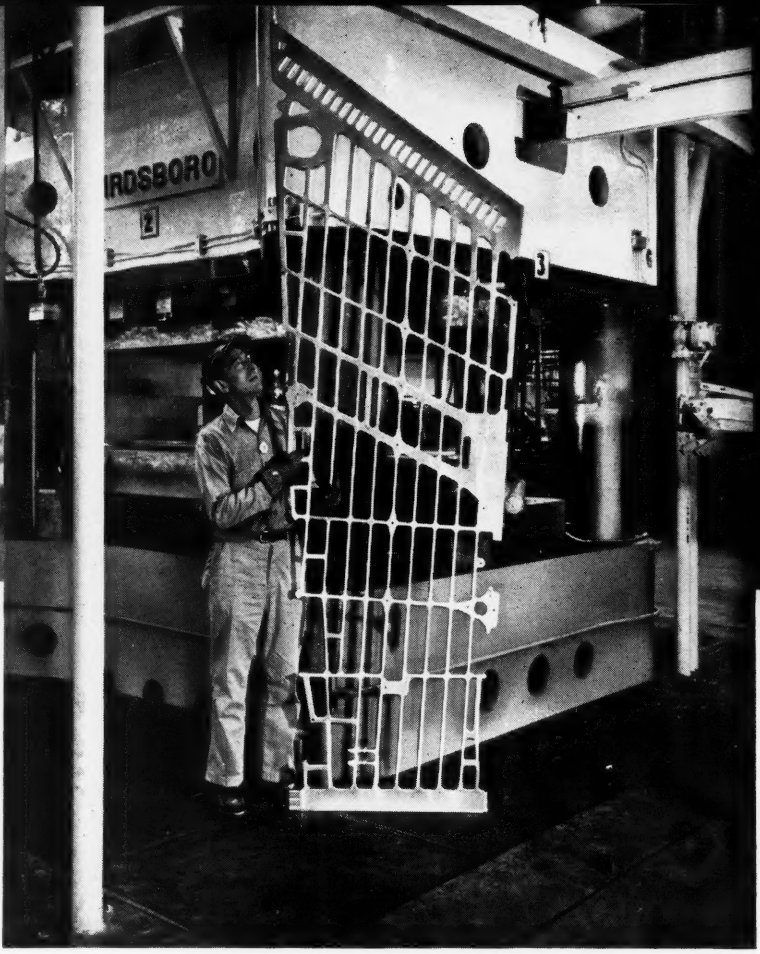
Another routing cutter only 0.525 inch in diameter is seen at *D* in Fig. 7. The helical angle of the single flute on this cutter is 20 degrees and the front or hook rake of the carbide blade, 10 degrees.

Various helical carbide milling cutters have been superfinished on the front face. In the superfinishing operation, 325 diamond grit is first used, then 600 diamond grit, and finally 1200 diamond grit. On all cutters the carbide blades are attached to the bodies by employing Easy-Flo silver solder.

Fig. 8. Drawings which give complete details of typical helical carbide end-mills that are being extensively used in the Boeing plant



North American
F-86 Sabrejet



By JOSEPH S. CORRAL
General Foreman of Machine Forming
North American Aviation, Inc.
Los Angeles, Calif.

ONE of the latest innovations in aircraft construction at North American Aviation, Inc., Los Angeles, Calif., is the use of large aluminum grids in the wings of the F-86H Sabre and FJ-2 Fury. For years airplane wings have been built with ribs and spars "catacombed" between the upper and lower skins. As the wings were made thinner and at the same time subjected to greater stresses, new means of bolstering the wings had to be devised. Engineers solved the problem by adopting grids made of long pieces of 75S aluminum plate routed to a complex pattern, as shown in the heading illustration, and then curved to the desired contour.

Six grids are required for one airplane, there being upper and lower grids extending from a point close to the end of one wing across the center of the plane to a point close to the outer end of the opposite wing. The grids are, of course, secured to one another. The largest grids are 116 inches long by 40 inches wide, and weigh 100 pounds each. All grids are approximately 1 inch thick. They are characterized by variable webs and cross-sections, being machined in limited areas as required to reduce the weight and at the same time retain sufficient strength to support anticipated loads.

One of the difficult problems was to devise a method of forming the grids to the required contour after they had been routed to their intricate pattern. It is necessary to curve the grids in a transverse direction in accordance with the required wing contour. The maximum height of the arc is approximately 3/4 inch.

This production problem was solved by heating the machined grids to a predetermined temperature in a furnace and then transferring them one at a time to dies which form them accurately to the required contour. The grid is held in these dies until it has cooled sufficiently to retain its shape, the process being known as "form-die quenching."

The reason die-quenching had to be adopted was that conventional forming processes do not overcome different degrees of spring-back in the grids caused by variable properties in the heat-treated metal. The problem is further complicated by changes in cross-section and warpage in the part itself caused by the relief of surface stresses in the machining operation. While forming may be done with the metal in the soft temper, the subsequent heat-treatment and water quench required to develop the full structural strength of the material cause the part to undergo serious warpage due to residual strains when the grids are water-quenched. Deviations from the required contour, warpage, and dimensional changes caused by water-quenching the grids are virtually impossible to correct.

Machining the grids involves several steps. First, the aluminum-alloy plates are skin-milled to the required thickness within a tolerance of plus or minus 0.005 inch. Then the many openings are routed on a radial type machine. All

North American Forms and Quenches Wing Grids in Dies

openings must be cut under size an amount corresponding to 0.118 inch per lineal foot so as to compensate for the thermal expansion that occurs during the form-quenching process.

Preparatory to the form-die quenching, the grids are placed flat in a multiple-shelf stand in a Lindberg electric furnace, seen in Fig. 1. Although the illustration actually shows a simple stand that accommodated only one grid, the stand which has recently been installed accommodates ten grids. One grid at a time is placed on a shelf so as to insure uniform heating. The furnace interior measures 18 feet in length by 5 feet in width by 8 feet in height.

An important requirement of the process is that the heated grids be transferred from the furnace to the forming and quenching die in the shortest possible time. Quick transferal has been made possible through an ingenious device which consists primarily of a vertical post suspended from a monorail and easily manipulated claws on an arm attached to the vertical post, Fig. 2. The claws are employed to grip the heated grids, as seen. There are four claws, two on each side of a rack mounted on the loading arm. These claws are actuated through a pneumatic cylinder on the post, and the complete loading arm can be moved vertically on the post through a second pneumatic cylinder. The two pneumatic cylinders may be seen in Fig. 3.

When a grid has been completely withdrawn from the furnace, the post is practically in line with the center of the Birdsboro hydraulic press used in form-die quenching. The operator of the loading device quickly swings the work through an arc of 90 degrees into line with the dies, illustrated in Fig. 4, and moves the grid horizontally into position on the die, Fig. 5. When the grid is released from the claws, it is automatically positioned by blocks provided around the lower die member, as shown in Figs. 6 and 7.

Attached to the upper end of the vertical post of the loading device (as seen in Figs. 2 and 4) is a hinged arm that is connected to a building column. On this arm is a pipe extending vertically downward several feet behind the oper-

Fig. 1. The first step in the form-die quenching of grids is to heat the grids in a furnace which is maintained at a closely controlled temperature.

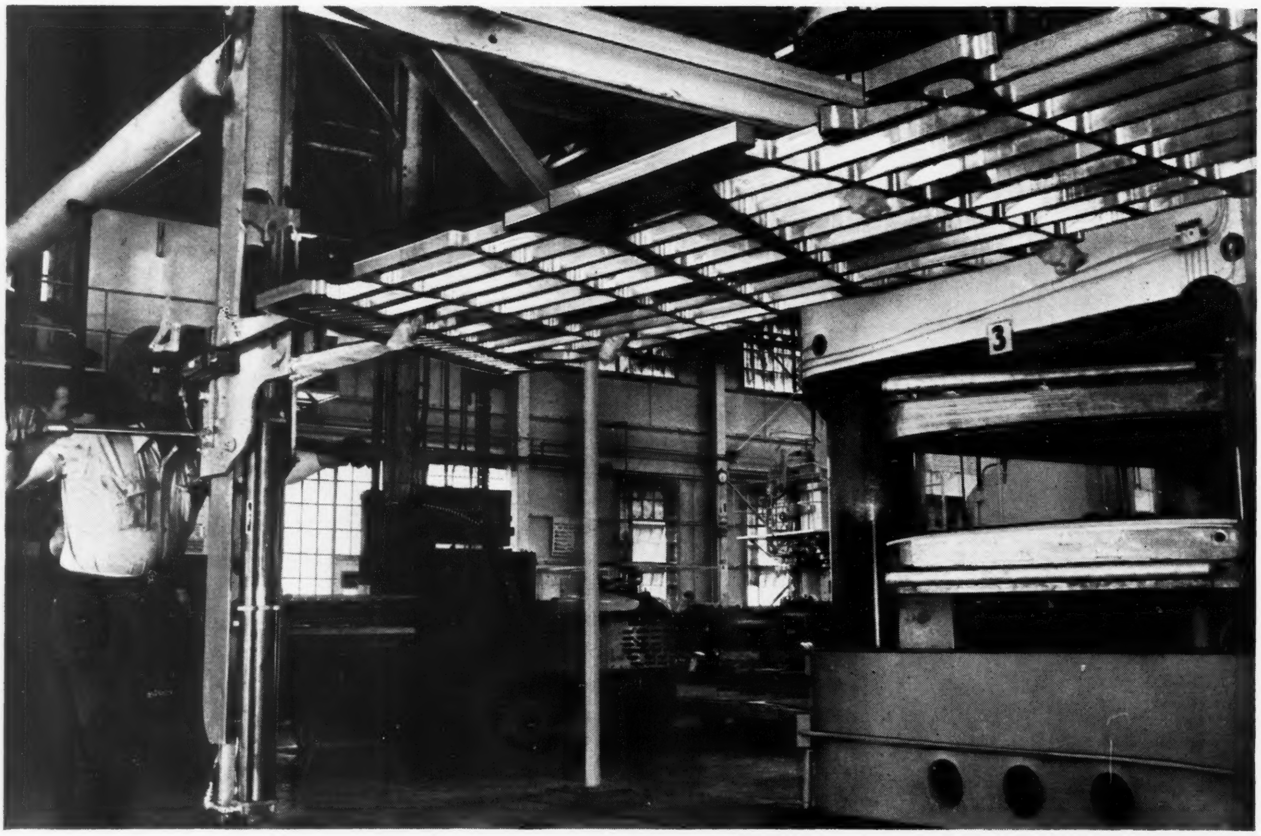


Fig. 2. An ingenious device is employed for loading and unloading the grids into and out of the furnace and hydraulic press.

ator's position. This pipe enables a helper to assist the operator in manipulating the grids into and out of the furnace and press. The loading device is, of course, also employed for removing the heated grids from the furnace.

In the forming and quenching operation, the top member of the die is forced downward on the grid to exert a high pressure. The work-piece remains in the dies for a specified length of time to insure adequate cooling and permanent set of the contour. Both the upper and lower die members are cored crosswise and lengthwise for the circulation of water delivered by the manifold, seen at the front of the die members in Figs. 4 and 6. The water maintains the dies at approximately room temperature. Fig. 7 illustrates the close adherence of a formed grid to the bottom die at the end of the quench.

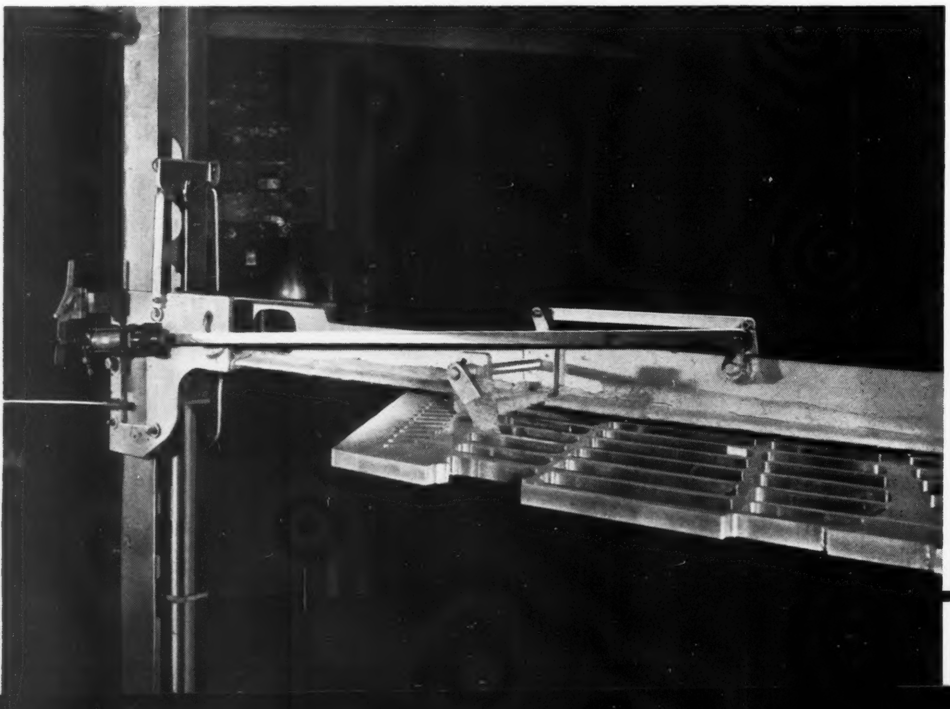


Fig. 3. Close-up view of the arm on the loading device clearly showing the mechanism that is employed for operating the grid-holding claws.

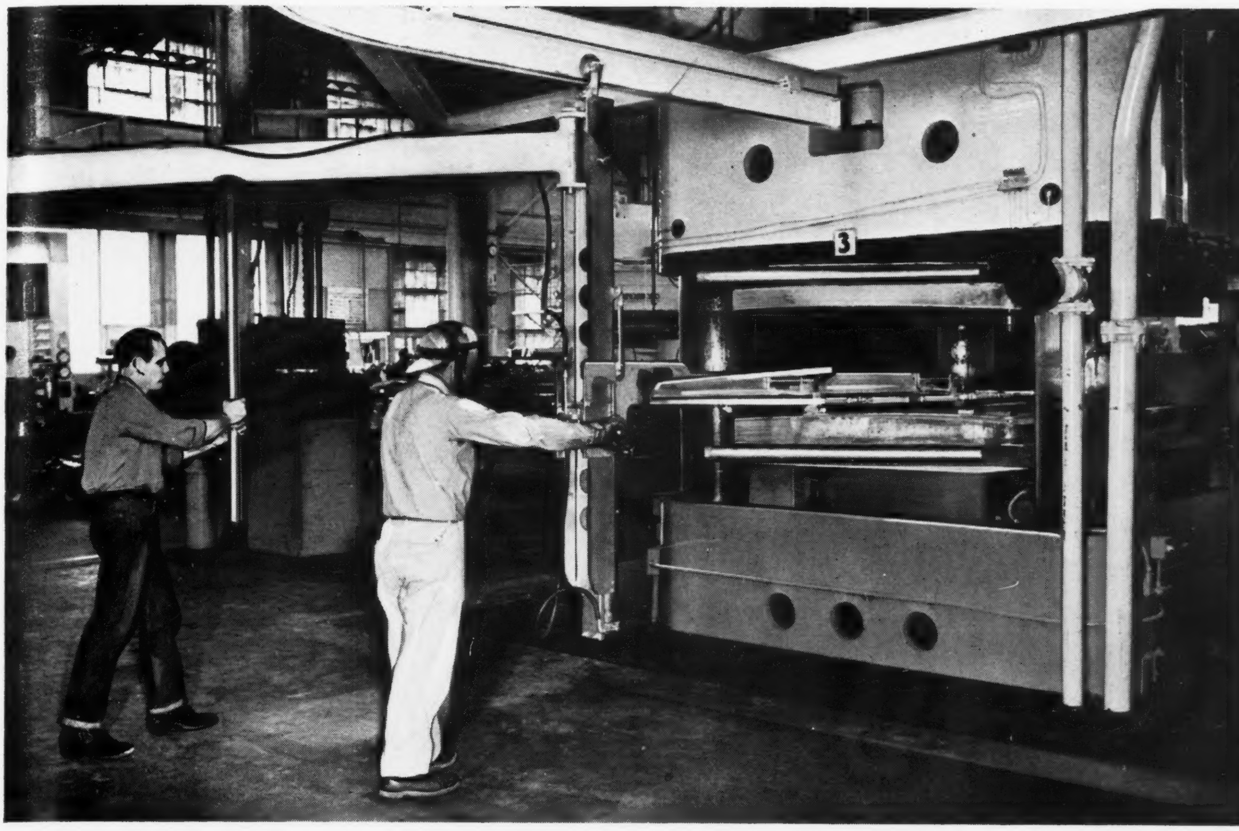


Fig. 4. The heated wing grids are transferred from the furnace to the Birdsboro hydraulic press in the shortest possible time.

Both die members are made of Kirksite. Great care is taken to insure accurate matching of the dies at all points of their contour. This accuracy is checked by placing about fifty blocks of steel —ground to a thickness of 1 inch within a close tolerance—at various points on the bottom die, Fig. 8. The top surface of each block is coated with Prussian blue.

Upon lowering the top die on these blocks, they will adhere to the top die, as seen in Fig. 9, when this die member is raised, provided the contour of both the top and bottom dies is correct at each point so that there is no air space between the contour of the top die and any block. Inaccuracy of the contours will be indicated by check blocks remaining on the bottom die when the upper die is raised. The heavy forming and quenching dies are brought to and from storage by means of

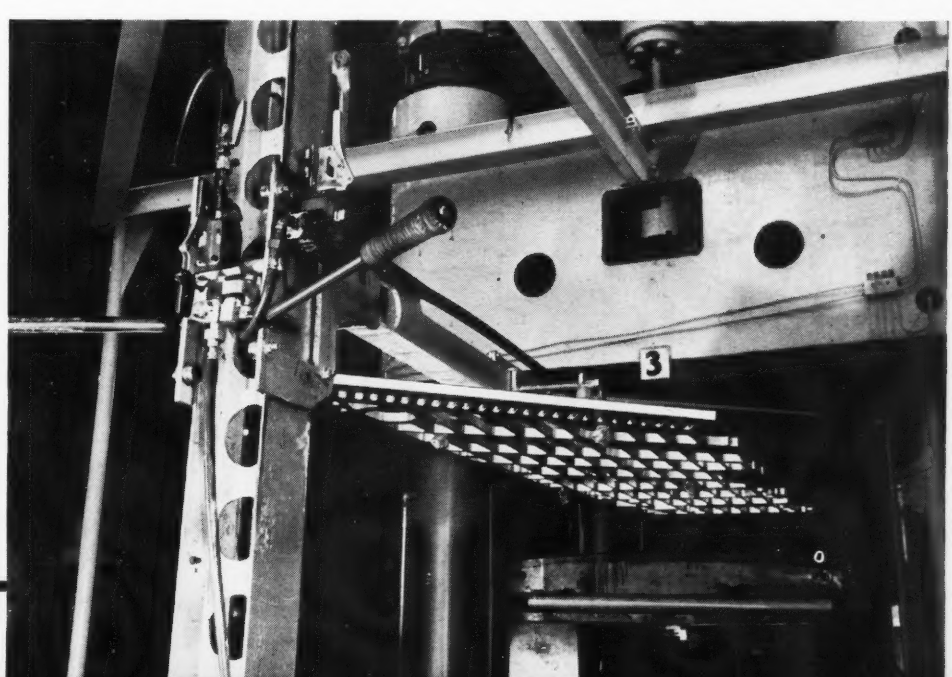


Fig. 5. When the grid is moved into press, it has been swung 90 degrees in horizontal plane from position it occupied when withdrawn from furnace.

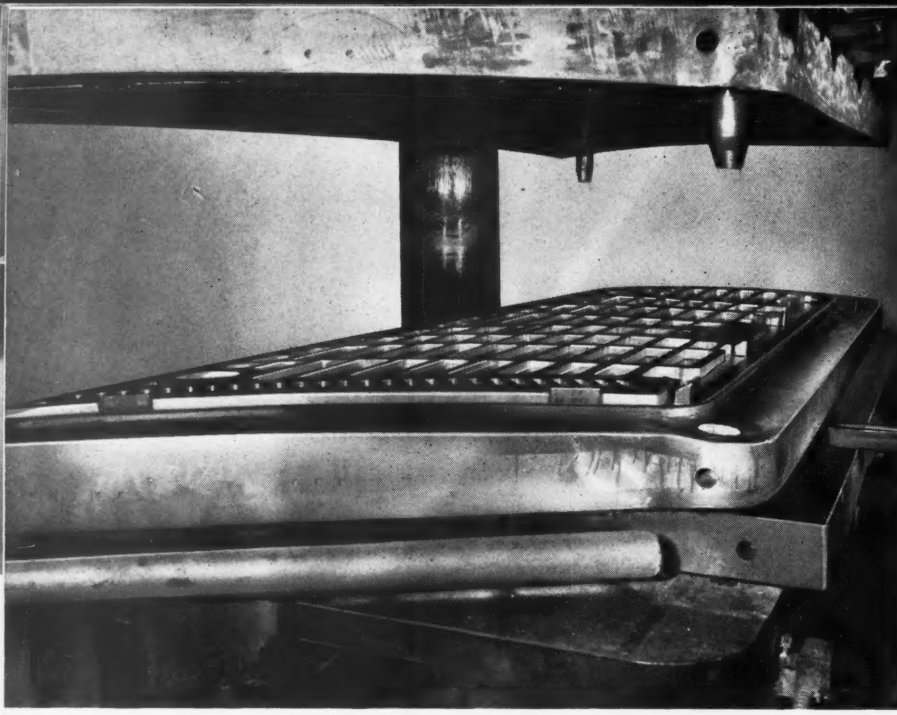


Fig. 6. Stops provided around the lower die insure accurate location of the heated grid prior to forming and quenching. The manifold that delivers water for cooling the bottom die can be seen in this illustration.

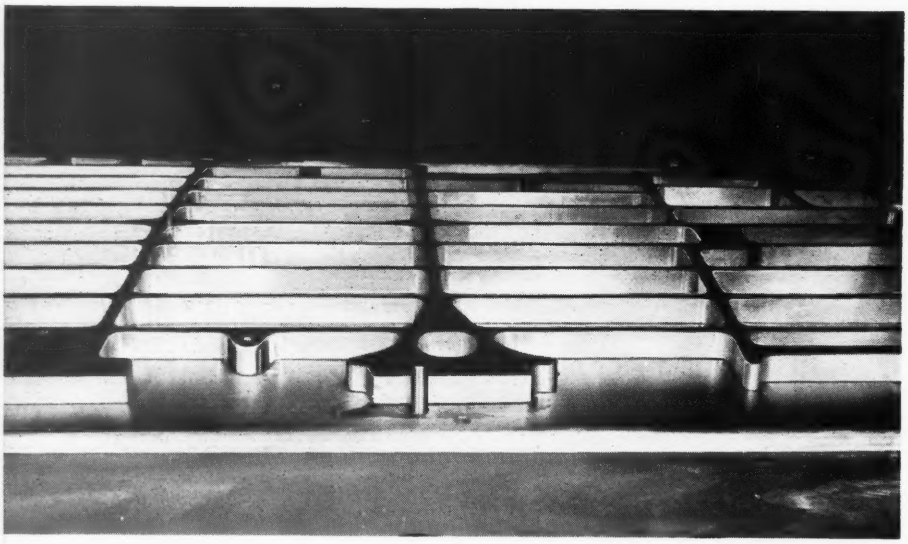


Fig. 7. The close adherence of the curved wing grid to the contour of the bottom die at the end of the form-die quenching operation is here clearly shown.

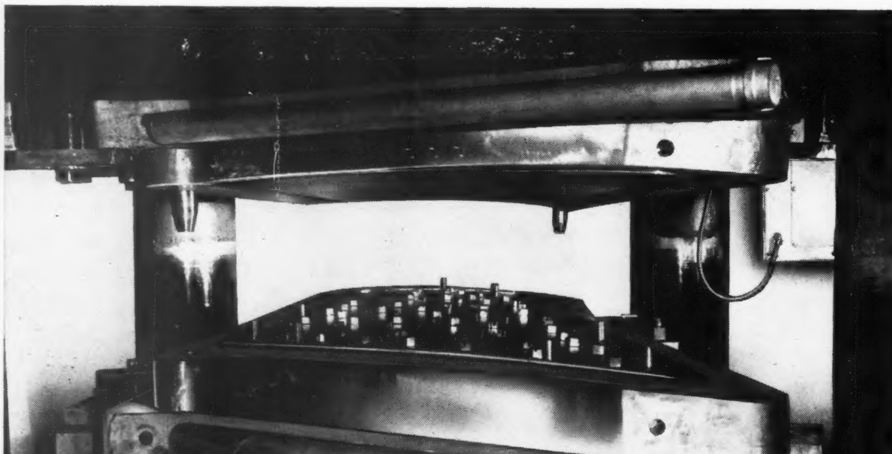


Fig. 8. About fifty steel blocks of uniform height and coated with Prussian blue on the top surface are placed on the bottom die member for checking the accuracy of the contour on both die members.

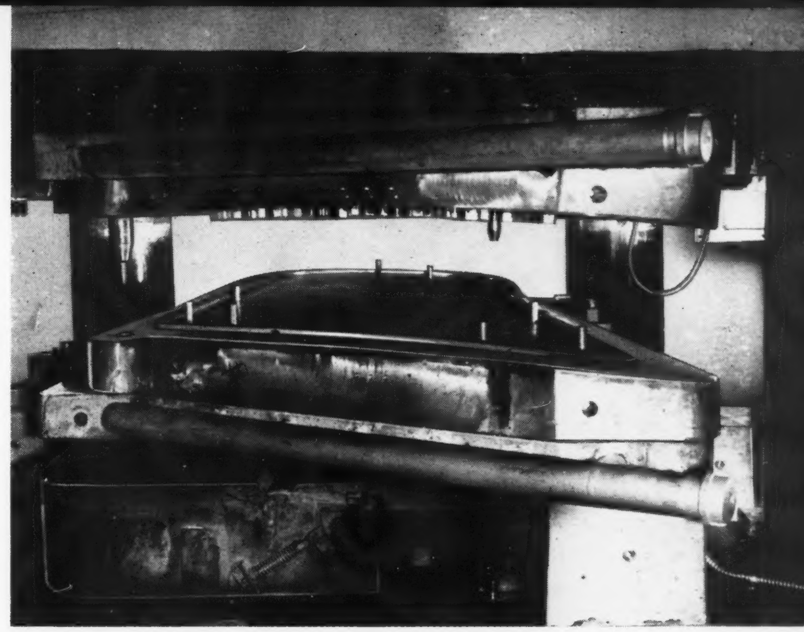


Fig. 9. When the upper die member is raised, the steel blocks seen in Fig. 8 will adhere to the upper die, provided the contour of the top and bottom die members is accurate at all points.

a special truck equipped with rollers on top that facilitate sliding the dies into and out of the press.

In this method of forming and quenching the grids, residual stresses and spring-back are eliminated because the process stretches the metal in all directions in fine and uniform increments. The same pressure is maintained throughout the forming operation to prevent contraction of the metal while cooling. The dimensional increase of the finished part is proportional to the coefficient of thermal expansion of the aluminum alloy at the processing temperature.

The form-die quench process has also been applied for the stress relieving and straightening of aluminum-alloy plates after they have been skin-milled. For example, Fig. 10 shows the warpage in a plate after it came from a skin-milling operation, while Fig. 11 shows the same plate after heating and quenching, it having been clamped between flat dies on an H-P-M hydraulic press. These flat plates are delivered to the hydraulic press from a furnace, seen in the background of the two illustrations, over the roller conveyor that is installed between the furnace and the press.

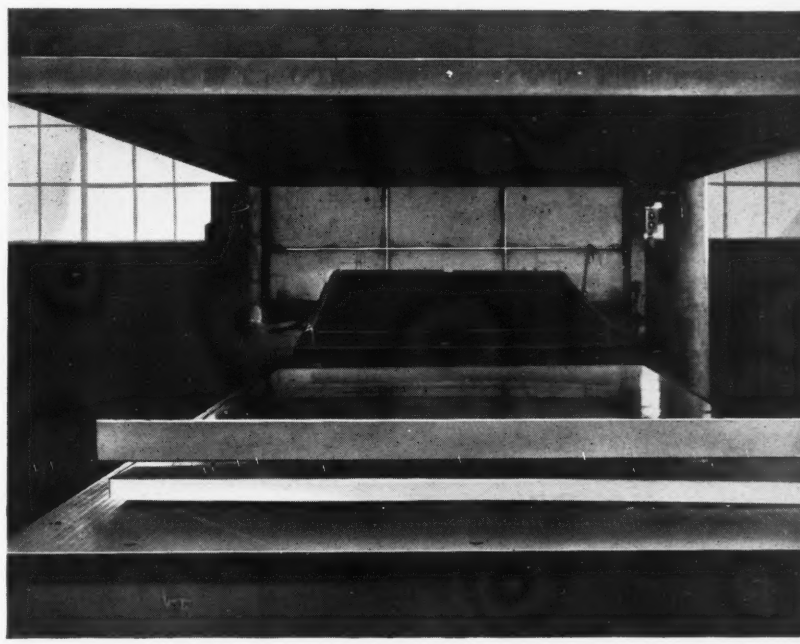


Fig. 10. (Center) The form-die quenching process is also employed for relieving stresses and straightening heavy aluminum plates after they have been skin-milled. This illustration shows the warpage in such a plate after skin-milling.

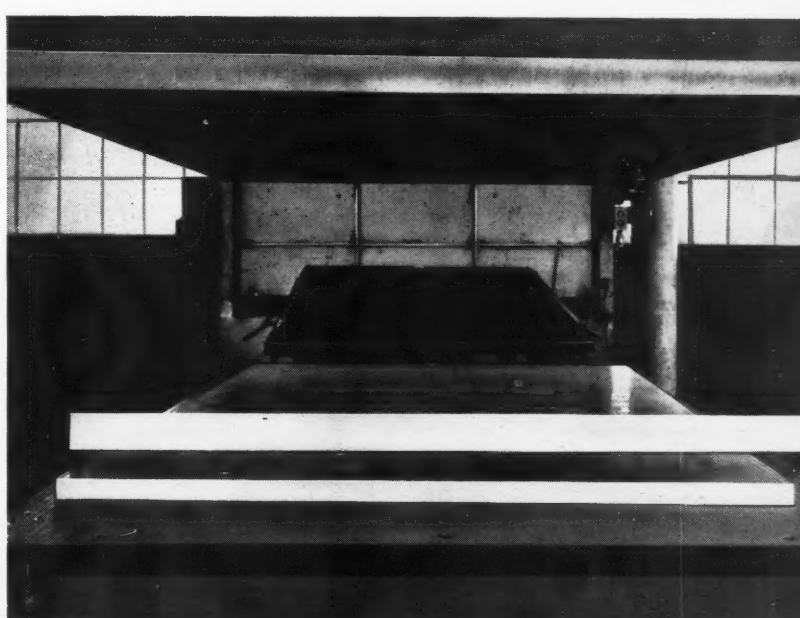
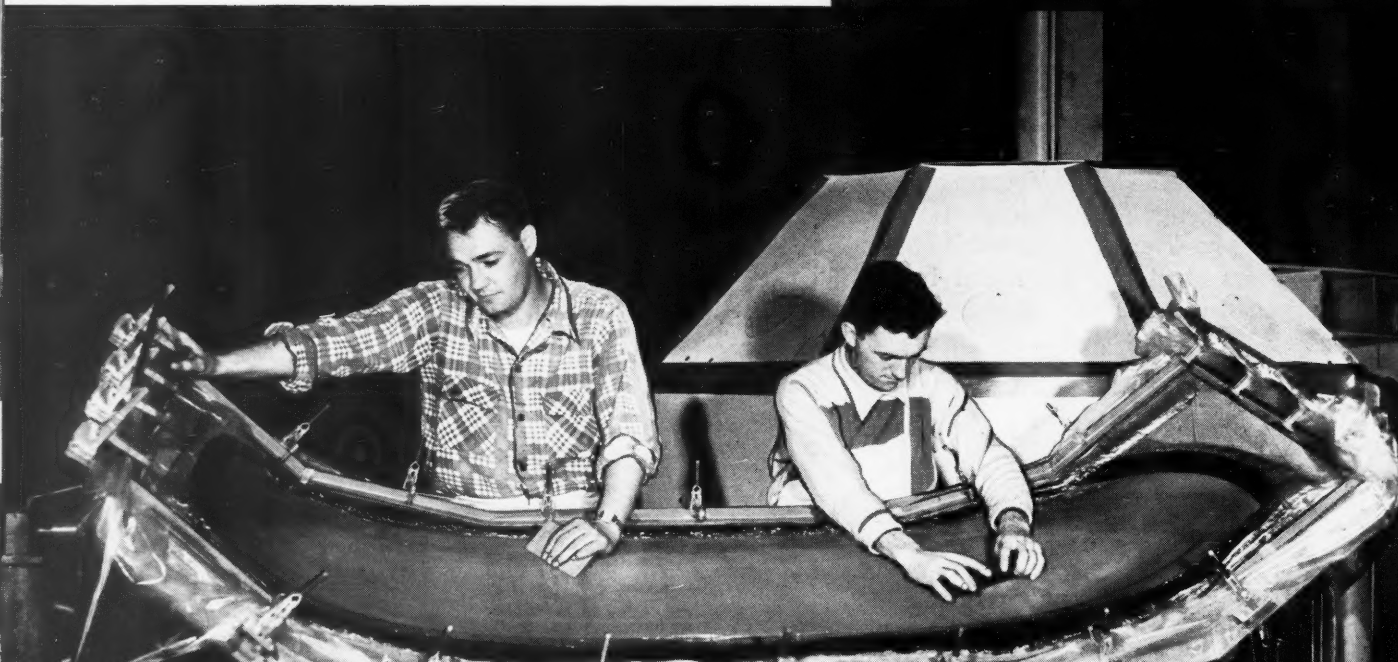


Fig. 11. The warped plate seen in Fig. 10 is here shown lying flat on the bottom die after it has been die-quenched. In the background is seen the roller conveyor employed to transfer the plates from the furnace to the press.

Unusual



SOMEONE very ably defined "research" as "a friendly attitude toward change." Perhaps the would-be lexicographer had in mind the research activities of the Lockheed Aircraft Corporation, Burbank, Calif. Three examples of how the receptiveness, imagination, and vigor of Lockheed research are being applied by production men in turning out more and better planes are here presented.

It has been a common metallurgical fact for a long time now that bombarding the surface of a metal part with tiny pellets will increase its resistance to fatigue, shock, and stress corrosion. "Shot-peening," as this process is popularly referred to, is nothing new. But when this company used shot-peening to put the curves into its integrally stiffened wing panel members, airframe makers were presented with a novel forming technique.

"Peen-forming" all started because of the trouble encountered in bending the panel. This member is milled from a thick slab of aluminum alloy so that a series of parallel ribs is left along the inner surface, serving as an integral frame. However, since the machining necessarily left the panel flat in cross-section, there still remained the job of bending the panel to meet aerodynamic requirements. Although the new panel represented a tremendous design simplification over the usual multi-piece skin and stiffener structure —for example, in a typical wing section, 1500 separate parts and 5000 rivets could be eliminated—some suitable bending technique had yet to be devised before the lower fabricating cost and better dead-load to pay-load weight ratio offered by the member could be realized.

While hot-forming might appear to be the logical answer, the proportions and size of the panels (up to 32 feet long by 46 inches wide), together with the tooling that would be involved, precluded the practicability of this method. On the other hand, no real enthusiasm could be mus-

Manufacturing Methods Developed by Lockheed

Lockheed Constellation

tered for any of the conventional cold-forming methods, since calculations showed that for this alloy, 75S-T6, a surface tension in excess of 20,000 pounds per square inch could be expected. This was a highly undesirable physical property to impart to the panel, in view of the fact that it would then be highly susceptible to stress corrosion.

It was at this juncture that the production methods group hit upon the idea that led to the eventual solution. It occurred to them that the stressed condition caused by cold-forming could be subsequently relieved by shot-peening the tensile side of the panel. Experimentation got under way by bringing the Metal Improvement Co., Los Angeles, Calif., into the picture.

In two and a half weeks, a special machine had been built for the job—a shot-peening cabinet, with a series of roller stands on each side, as can be seen in Fig. 1. In operation, a panel is slowly conveyed through the cabinet from one series of roller stands to the other. As it passes through the cabinet, the panel is pelted with a rain of fine round shot emitted from a battery of nozzles. The shot is expelled by means of air pressure. The drive chains of the conveying system are shown in Fig. 2, and the details of the nozzles are shown in Fig. 4.

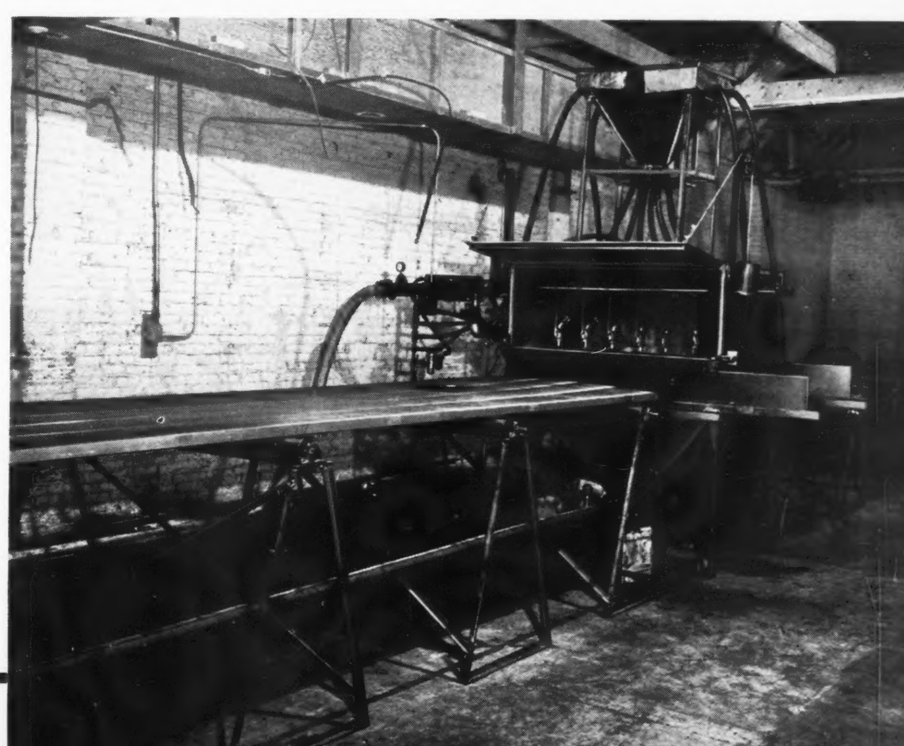


Fig. 1. Wing panel being conveyed over first series of roller stands of shot-peening machine. Shot is stored in hopper above cabinet.

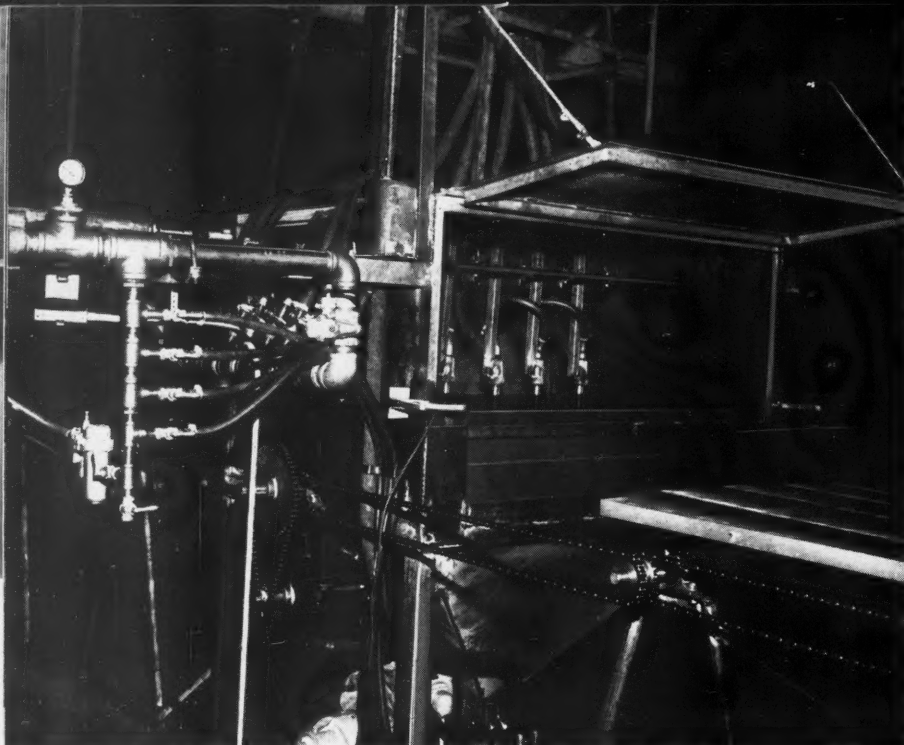
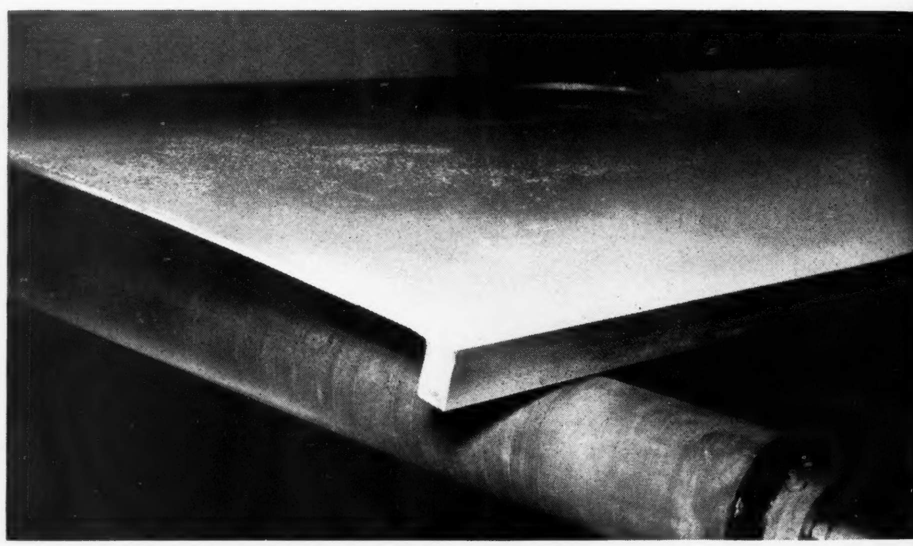


Fig. 2. Conveyor drive originates at electric motor beneath the cabinet and is transmitted through chains meshing with sprockets on the rollers.

Fig. 3. Peen-formed curvature can be seen as panel is conveyed over roller stands after leaving cabinet. Shot collects in a separator to remove imperfect pellets, then automatically returns to hopper.



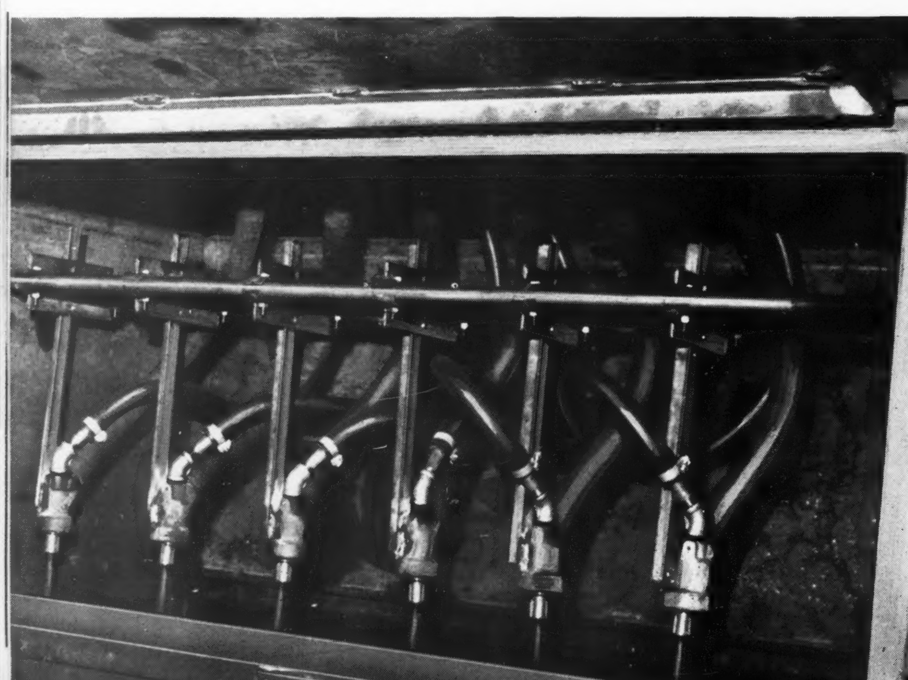


Fig. 4. Independently adjustable air hoses and shot hoses lead directly to each of the six nozzles used in shot-peening operation.

Fig. 5. Integrally stiffened extruded panels reduce both the fabricating costs and the weight of this fuel sump tank used in the F-94 turbo-jet.

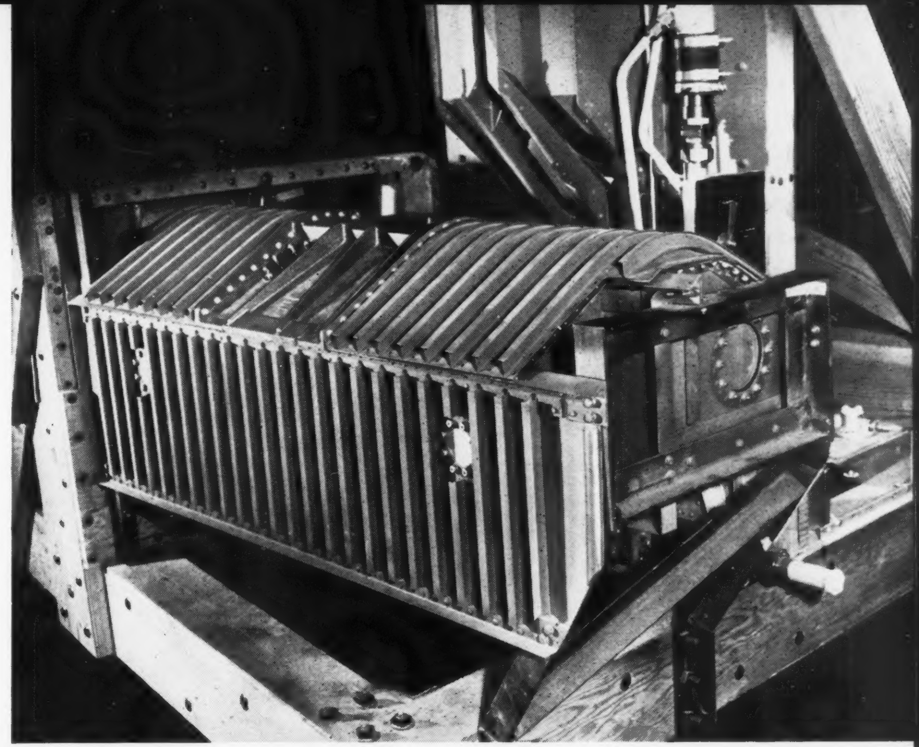


Fig. 6. The tubular contour simplifies the extrusion process. Although the ribbing is an integral part of the extrusion, these sections bear little resemblance to the finished fuel sump-tank panels.

Fig. 7. Sections of extrusions for smaller panels can be readily unrolled manually. Large panels are handled in a power brake.

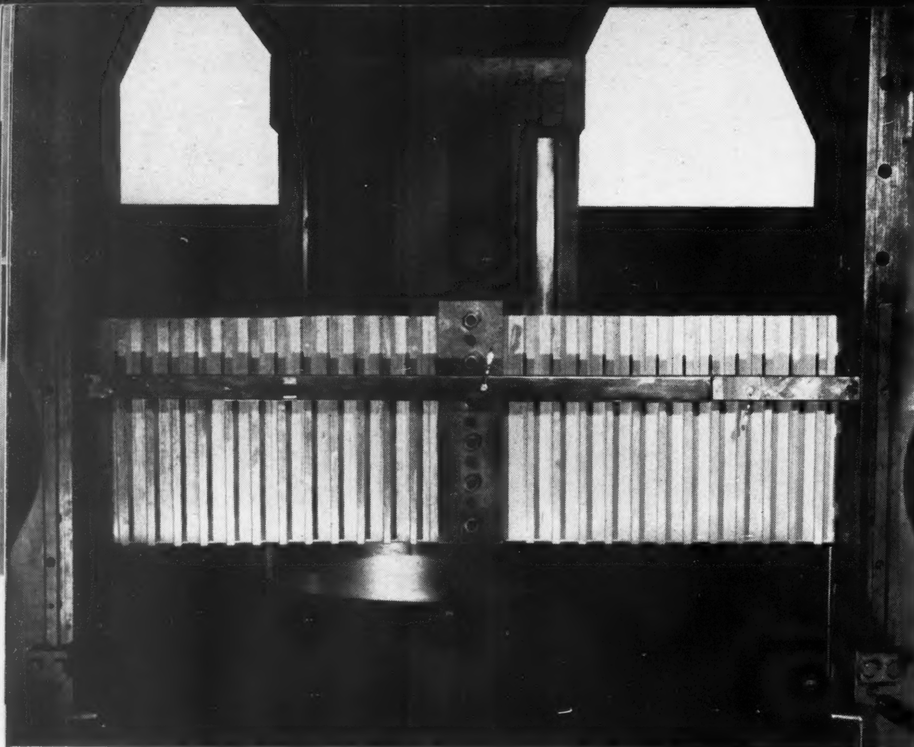


Fig. 8. A slight stretch in this Hufford press removes all ripples and waviness.

Typical sections of the wing panel were shot-peened, and it was found that the technique permitted them to assume considerable curvature. However, to obtain a uniform curve in a section which might vary from 0.05 to 0.5 inch in thickness within a space of 2 inches brought up new difficulties. The solution lay in varying the peening intensity of the nozzles, the pressures being regulated in proportion to the thickness of the metal sections. Through trial-and-error methods, proper intensities were established, and a skilled operator was able to form a panel in a single pass through the shot-peening machine. Moreover, if more than the desired amount of curvature was obtained because of too high an intensity, then the curvature could be reduced by shot-peening the opposite surface of the panel.

The most important single fact to come out of these experiments was that the panels could be formed to the desired curvature by shot-peening alone For example, the curvature of the panel seen in Fig. 3 was produced entirely by shot-peening. Rather than play merely a secondary role—that is, to relieve stresses set up in cold-forming, as was originally contemplated — shot-peening supplied the entire answer to the forming problem. Any skepticism shared by the engineers about the possibility of shot-peening the curvature was dispelled by the high degree of accuracy that was obtained. The particular curvature specified had a 300-inch radius on the inboard end of the wing panel and a 180-inch radius on the outboard end.

The theory behind peen-forming is that as the outer surface of the panel is bombarded into a compressive layer, the surface is lengthened, and because it is then longer than the inner surface, curvature takes place. As in the conventional applications of shot-peening, the value of the compressive layer is that fatigue fractures cannot originate and cracks cannot readily grow in compressively stressed material. Then, too, an incidental result of this method of forming is that a beneficial compressive stress is also set up in the inner surface of the panel. This is not traced to the shot impact, since only the outer surface is bombarded, but is a product of the bending action itself.

A unique feature of peen-forming is that no tooling is required, save for templates used to check the curvature. The success of the operation is, in the main, a matter of operating skill and experience. Much depends, of course, upon the operator's judgment in selecting just the right amount of air pressure for each of the nozzles that are located in the cabinet of the machine.

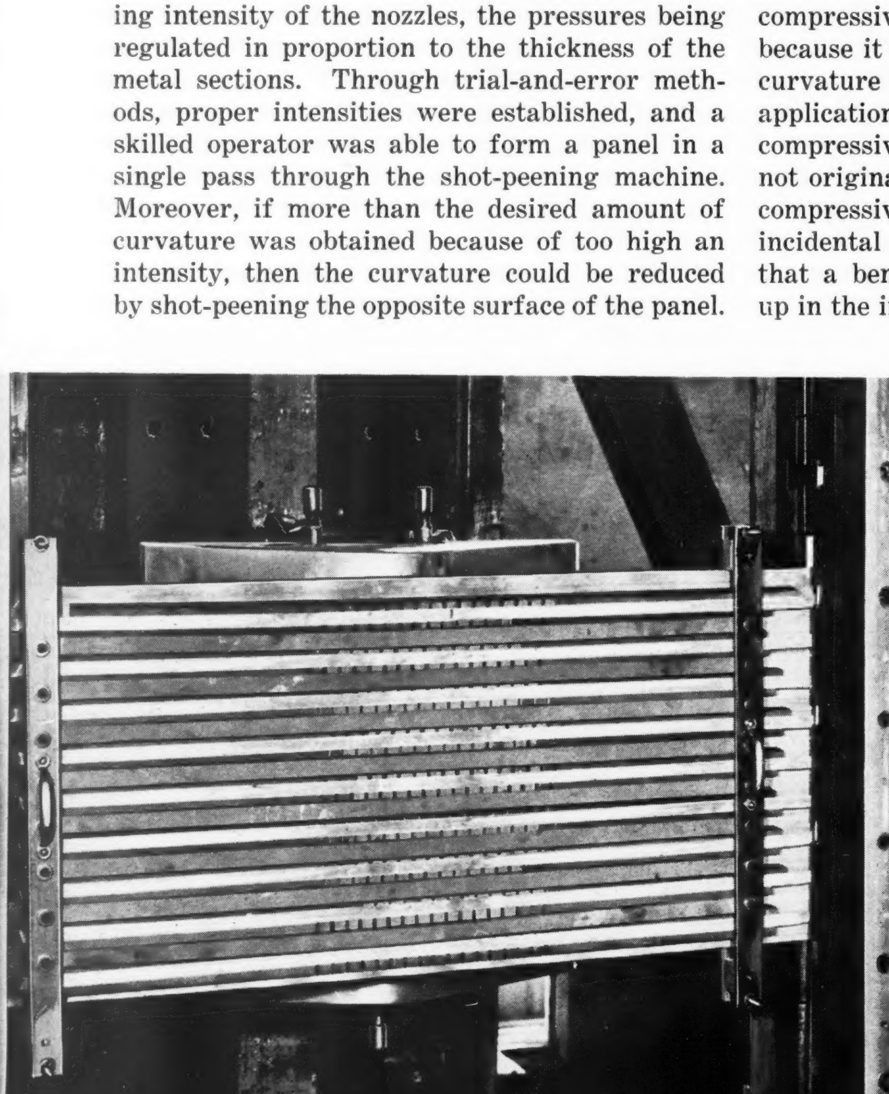


Fig. 9. Cover panels receive required curvature from a radius die mounted on slide of press.

Fig. 10. Plastic drop-hammer die employed on aluminum duct seen in the foreground of illustration

In addition, he must concern himself with five other variable factors: shot size, shot feed, nozzle size, nozzle distance above the work, and conveying speed.

Integrally Stiffened Panels from Tubular Extrusions

Successful use of integrally stiffened members has not all been confined to the new wing panel at Lockheed. In Fig. 5, for example, is shown the sump tank for the fuel system mock-up of the F-94 turbo-jet. Panels for the sides, bottom, and most of the cover are made of 24S aluminum, integrally stiffened. The method for ribbing the panels of the fuel sump tank and that for the wing are entirely different. Because of the proportions of the wing panels, the ribs are created by milling the panel from a thick slab, whereas the smaller panels of the tank are fabricated from sections of tubular extrusions of which the ribs are an integral part.

Cross-sections of the material used for the tank panels are shown in Fig. 6. The pattern at the left, having T-shaped stiffeners, is used for the two sides and cover; that at the right, having bulb-shaped stiffeners, is used for the tank bottom. Thick beads visible along the lower surface of each extrusion are not part of the finished panels, but are provided to simplify the extruding problem by balancing the amount of material at all points in the cross-section. The tubes are delivered from the mill in 5- and 10-foot lengths.

Preliminary in-plant fabrication entails cutting the tubes into short sections, splitting them lengthwise between the beads, heat-treating, unrolling, and stretching in a 200-ton Hufford press. Illustrated in Fig. 7 is the operation of manually unrolling the heat-treated sections. In the background can be seen the press in which the subsequent stretching operation is performed.

A close-up view of two pieces being stretched simultaneously is shown in Fig. 8. A stretch increase of the original dimension of approximately 1/2 to 1 per cent removes all transverse ripples and waviness developed in heat-treating and unrolling. Panels for the cover must, in addition, be curved, as can be seen in Fig. 5. Bending is done by means of a radius die mounted on the slide of the stretch press, as can be seen in Fig. 9. In this operation filler strips are placed between the ribs to prevent them from collapsing under the bending pressure. Gashes across the middle of the strips keep them from buckling so that they can be used again.

Integrally stiffened extrusions have reduced the number of parts that would ordinarily constitute the panels of this tank an estimated 90 per cent. Also, the 1500 rivets required by conventional design and the possibility of leakage around the rivets have been dispensed with. By the same token, costly and heavy sealing compound requirements are reduced. The use of

Fig. 11. Smooth finish necessary for the surface of this intake duct fairing is produced with a plastic drop-hammer die.

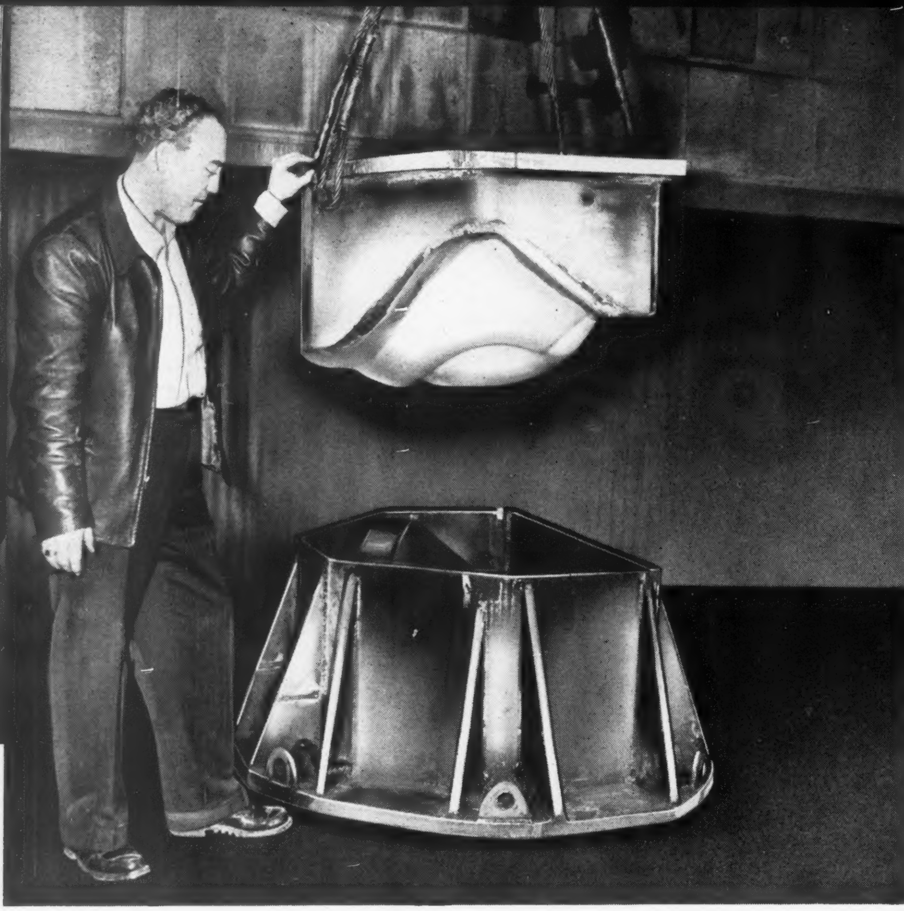


Fig. 12. Plastic drop-hammer die employed to produce the fairing shown in Fig. 11

of new type plastic tools. At Lockheed, plastic tooling ceased to be an experiment three years ago; it is now a well integrated and expanding operation with eighty-eight men in a plastic tool shop.

Success with the new tools has been such that their application has already extended to forming the bulk of aluminum-alloy parts made at the plant, with the exception of those requiring severe pressures or heat. Already the plastic shop has made more than 135 double-action dies, 30 stretch press dies, 10 hydraulic press dies, and 6 experimental drop-hammer dies. It is contemplated that before long 60 per cent of the drop-hammer dies will be made of plastic.

extruded material also assures a smooth inner surface for supporting the bladder cell which is contained in the tank.

Plastic Tooling Revolutionizing Forming Operations

High tooling cost, always a factor to contend with in aircraft manufacture, is becoming of diminishing importance as the use of plastic tools and dies continues to make inroads in the industry. Large aluminum-alloy parts are being formed, trimmed, and drilled by a whole family

Plastic dies are constructed by a plaster splash technique from a master. The splash mold is placed in an inverted die box, which is then filled with a phenolic plastic poured through holes in the bottom of the box. Curing is done by letting the mold set overnight, or by setting in an oven, generally about eight hours at 200 degrees F., depending upon the volume of the material. After curing, the plaster is knocked off and a metal drawing-ring is placed around the mold. The plastic is then sprayed with primer to the thickness of the part to be made. Later, the first plastic casting is used for a mold in making its mating die. A parting agent prevents the two members from sticking together.

The plastic used is readily available in ample supply. It replaces materials such as zinc and lead, which are today both scarce and costly. The principal material used is a phenolic plastic known as R-72S, or tool plastic, developed by the Rezolin Co., Los Angeles, Calif. In the past

Fig. 13. Inner skin of 14-foot door of a patrol bomber is made with this huge plastic punch.

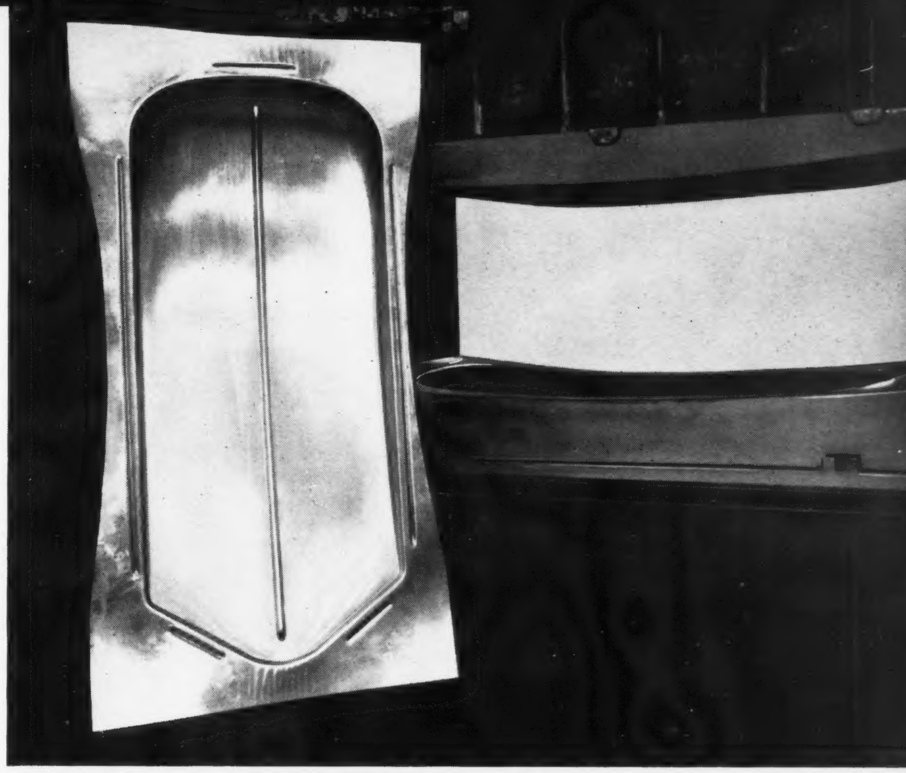


Fig. 14. Wing-tip skins, both left and right, are made in a plastic double-action die.

two years, Lockheed has used 197,000 pounds of phenolic plastic.

A plastic die is able to be cast "net," thus eliminating the need for shrink patterns, since phenolic plastic is dimensionally stable. Another advantage is the relatively lighter weight of the plastic, making the material particularly desirable for large tools and dies. Also, since it is possible to make component parts in bigger units, assembly is simplified. As a case in point, stretch press dies as large as 15 by 4 feet have been made of plastic and can be easily handled at their weight of 3500 pounds. The weight of metal dies would make handling difficult.

A plastic die can be cast on a single shift in the shop and be ready for use in forty-eight hours under normal conditions, because of savings in molding, "blueing in," grinding, and polishing. Almost no grinding and polishing are required, since the finish on the die is controlled by the finish on the mold. For example, Lockheed made forty-two plastic double-action dies for its F-94 all-weather fighter air duct in ninety days.

Tests have shown that parts are more uniform due to the wrapping action of the dies, which have a certain amount of flexibility. Scratches from die action do not occur, and parts of different gage can be made with the same tools. Furthermore, breaks or cracks in plastic dies can be repaired by patching, whereas a damaged metal die is a total loss.

A few examples of plastic tooling applications are shown in Figs. 10 to 14, inclusive. In Fig. 10 can be seen a plastic drop-hammer die used in the production of the aluminum duct in the foreground. Also made with a drop-hammer is the high-intake duct fairing, Fig. 11, the die for which is shown in Fig. 12. An idea of the large size of some plastic tools can be gained by examining Fig. 13. This is a plastic punch used on the inner skin of the 14-foot door of a Neptune patrol bomber. A wing-tip skin, together with the double-action die in which it was made, is shown in Fig. 14.

Other uses of plastic tooling at Lockheed in addition to making dies are for master molds, Keller blocks, router and shaper fixtures, drill jigs and cages, scribe and trim fixtures, molds for plastic parts, production parts, slave parts, contour surfaces on steel fixtures, and for the cementing of bushings in drill cages. Master molds made of plastic are much more durable than plaster molds, and cost very little more to construct. In Fig. 15 is shown a mold for forming a Royalite plastic trim cover, used for window frames and door panels on one of the Constellations. In the heading illustration is shown a thin-walled plastic mold for aft-sections of range and sense antennae on patrol bombers.

Fig. 15. Mold for forming Royalite plastic trim cover used for window frames and door panels

Convair with

By
CHARLES O. HERB

ADEQUATE tooling for the drilling, reaming, routing, and sawing of contoured and compound-contoured parts and assemblies has always presented a knotty problem in aircraft manufacture. One solution which the San Diego, Calif., plant of the Consolidated Vultee Aircraft Corporation has carried out with significant success is the use of fiber-glass laminated tooling. Drill jigs, sawing fixtures, routing forms, templates, supporting legs, and many other types of tooling—to well over 300—have already been made and applied by the concern.

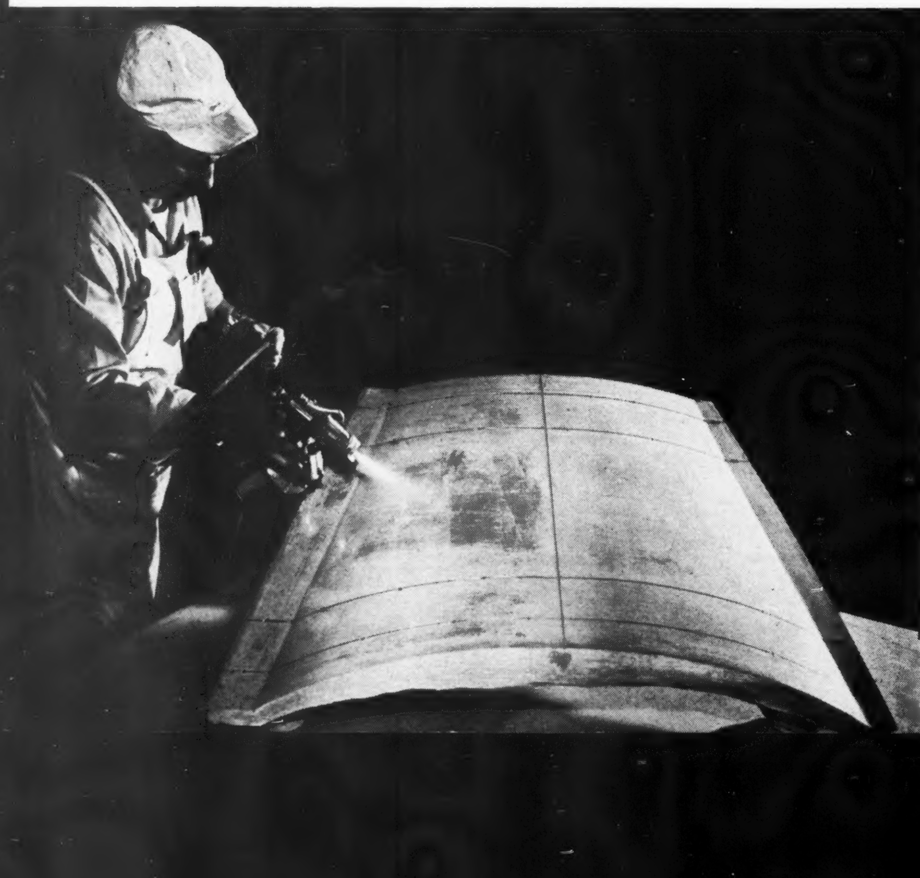


Fig. 1. Three coats of lacquer and one coat of separating wax are sprayed on a plaster or plastic mold to prevent sticking of the fiber-glass laminate.

Saves Money and Metal
Fiber-Glass Tooling

Convair XF-92A
Delta Wing
Research Interceptor

This type of tooling has the advantage of being light, durable, easily reworkable to suit minor engineering changes, and relatively inexpensive. In addition, the fabrication of fiber-glass tooling is simple enough to be accomplished by the average shop worker instead of requiring the skill of a highly trained mechanic or toolmaker. Fiber glass makes possible low-cost tooling for parts produced in moderate lots, and the practice should also be applicable in many shops outside of the aircraft industry. In building the Convair Liner 340, tooling of this type is used extensively in fabricating such assemblies as the main landing gear doors, nacelle sections, and leading edges of wings, flaps, and stabilizers.

The first step in making a fiber-glass jig or other part is to provide a mold on which sheets of fiber glass are placed one at a time. These molds are customarily made of plaster or from a phenolic plastic. However, actual work-pieces

Fig. 2. Strips of wax edging or fiber-glass mill ends are fastened to molds to establish the perimeter of the tooling and prevent draining of the plastic compound.

Fig. 3. Sheets of fiber glass are cut to the approximate outline from a paper pattern.

Fig. 4. Applying the first fiber-glass sheet to a plaster mold, the sheet being brushed with a plastic mixture.

Fig. 5. Succeeding layers of fiber glass are applied in the same manner until the required thickness is reached—generally about 5/16 inch.

can also be employed as molds. A typical plaster mold is seen in Fig. 1.

In preparation for building up the fiber-glass construction, the mold is sprayed with three coats of lacquer and one coat of paste wax to insure ready separation of the fiber glass from the mold when the part has been completed. Then on large molds, wax strips are fastened on the mold to establish the perimeter of the jig or other piece of tooling to be produced, this step in the process being illustrated in Fig. 2. Sometimes, fiber-glass mill ends are used instead of the wax strips. They prevent draining off of the polyester or plastic compound. Next, a paper template is cut out to serve as a pattern in cutting the sheets of fiber glass so that they will conform approximately to the surface of the mold. The girl in Fig. 3 is engaged in cutting fiber-glass sheets to such a template.

The manner of applying the first sheet of fiber glass over a mold is illustrated in Fig. 4. The material is saturated with a liquid compound that consists of resin and a catalyst, the polyester mix being applied with a paint brush, as shown in Fig. 5. Succeeding layers of fiber glass are applied in the same manner, one sheet at a time, until the required thickness is obtained. This is generally about 5/16 inch. Twelve to fourteen sheets result in a built-up thickness of 1/4 inch. Fiber-glass matts are used between sheets for certain types of jigs. The matts are thicker than the sheets and reduce the number of sheets required. Three matts and two outer sheets will give a fabrication 1/4 inch thick.

When the required thickness has been obtained, the fiber glass is allowed to remain on the mold for approximately twelve to forty-eight hours to insure air-hardening. The cured blank is then readily taken from the mold, as indicated in Fig. 6. The ability to cure fiber-glass laminates at room temperature, if time is not important, eliminates the need for ovens or other heating equipment. The curing time varies from one to four hours, depending upon the type of tooling.

Then the fabrication is taken from the mold and the edges smoothed by applying a portable sander, as seen in Fig. 7, or by using hand files. The heading illustration shows a drill cage or jig being removed from the afterbody assembly of a nacelle following the drilling of a large number of holes. The convenient manner in which openings may be cut in a fabricated sheet of fiber glass is shown in Fig. 8, while a close-up view of

Fig. 6. Lifting a cured blank from the plaster mold. The curing time varies according to the setting resins used, the type of mold, and the urgency of the tooling.

Fig. 7. Rough edges on cured fiber-glass laminates are smoothed by means of a portable sander or applying hand files.

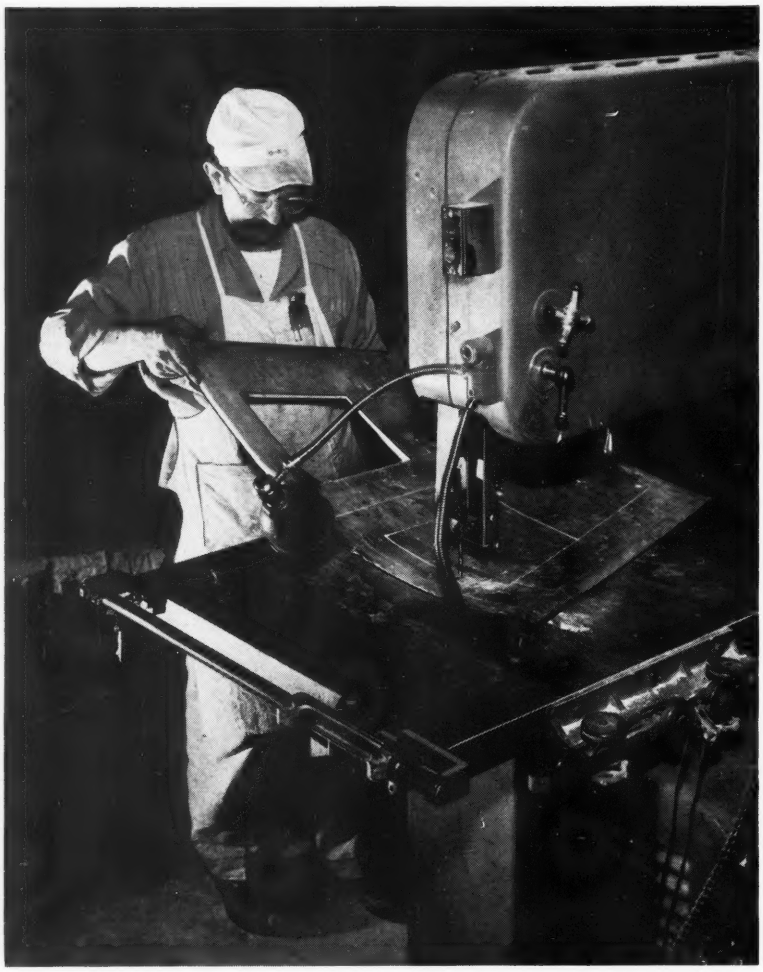
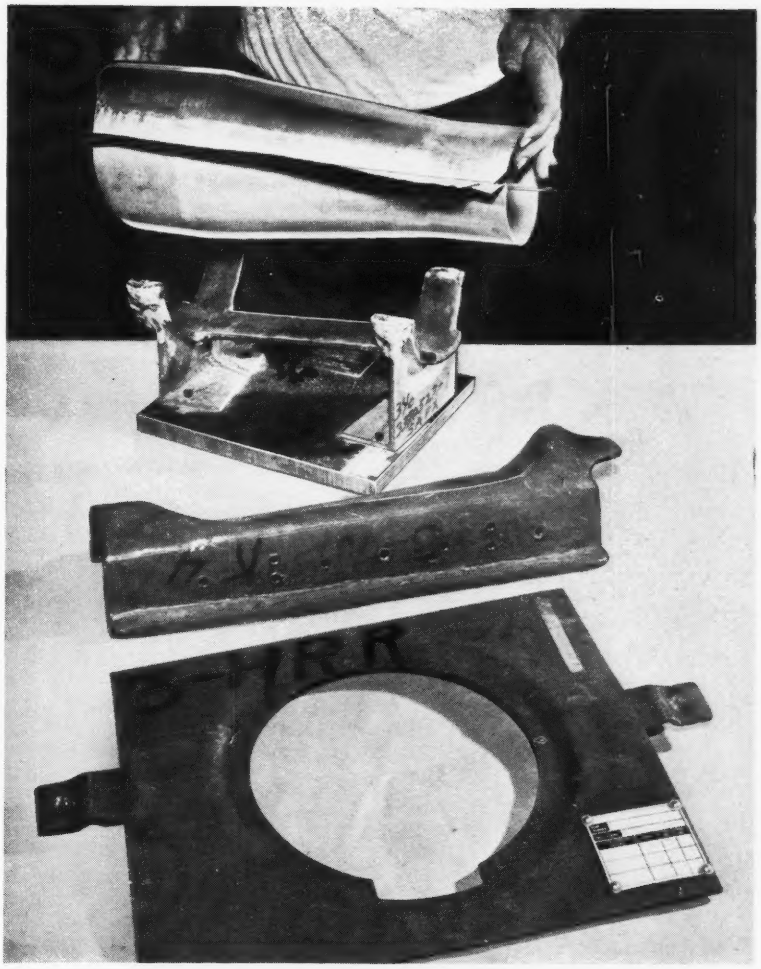


Fig. 8. Excess material can be readily sawed from fiber-glass tooling, as here illustrated, in order to reduce the weight and facilitate the handling of tools of this type.

Fig. 9. Close-up view of a drilling operation on an airplane component, in which the drill is guided by bushings in a fiber-glass jig.

Fig. 10. Types of fiber-glass tooling – (top) supporting fixture for sawing and trimming operations, (center) a drilling and trimming fixture, and (bottom) a routing form.



a typical drilling step performed in this cage with a portable electric drill is seen in Fig. 9.

Drill bushings are customarily provided in holes drilled through the fiber glass or located on the mold and secured during the building-up process. Drill jigs as long as 30 feet have been made for operations on the leading edge of B36 planes for drilling all rivet holes, there being approximately 15,000 holes of this type on the plane mentioned. These 30-foot jigs were made in several sections.

Smaller fiber-glass tooling examples are illustrated in Fig. 10. At the bottom is seen a form used for grinding the cutter in routing operations on aluminum sheets. In the middle of the illustration is a fiber-glass drilling and trimming fixture for a part of complicated contours, and above that is a fixture employed for holding a tapered sheet-metal piece during sawing and trimming operations.

A rather unusual routing form recently made from fiber-glass laminates is 8 feet in length by 2 1/2 feet in width. Large-sized openings reduce the weight of this routing form.

Modern

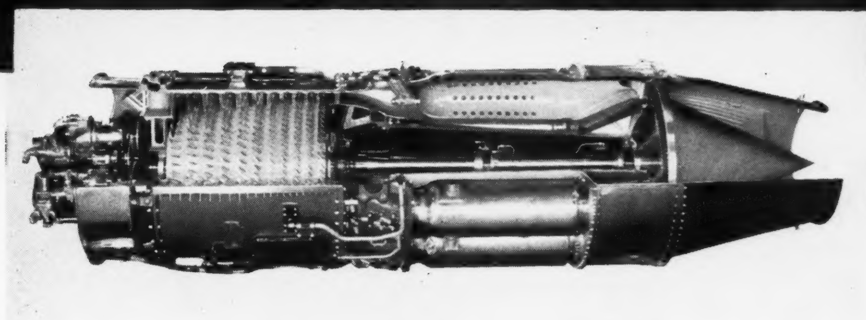
By
CHARLES H. WICK

New Machines and Vastly Improved Manufacturing Methods have Permitted Greatly Increased Production of Urgently Needed Turbo-Jet Engines. This Article Describes Automatic Cam-, Air-, or Hydraulic-Controlled Duplicating Lathes; Two-Wheel and Double Work-Head Grinding Machines; and Unusual Broaching, Boring, Drilling, Welding, and Burring Operations

HIGH-QUALITY precision parts made from tough, heat-resistant alloys are necessary to withstand the extreme speeds, elevated temperatures, and tremendous stresses encountered in jet engines. At the Allison Division of General Motors Corporation, Indianapolis, Ind., new facilities provide for the precision manufacture of turbo-jet engine parts on a production basis. Improved methods and new machines have been especially designed to solve production problems that have arisen in manufacturing these power plants.

Forged steel compressor wheels are rough-turned, faced, and drilled on Bullard eight-station Mult-Au-Matics such as the one seen in Fig. 1. Because of the large size of the forged wheels, only four of the parts can be mounted on the indexing table at one time. Single-station indexing is, however, employed with tools mounted at all eight stations. Especially wide ways

Tooling Speeds Output of Allison Turbo-jets



Allison J35 Turbo-Jet Engine

and extended feed rods are used at all stations on the machine.

The forged steel compressor wheels are located against their rim face and gripped on their outer periphery by means of a power-operated chuck at the first station. All of the tools are single-point and carbide-tipped with the exception of the drills.

When the forged wheels have been indexed to the second station, six single-point, carbide-tipped tools held in a single tool-block are fed downward to rough-turn and bore part of the wheel rim and hub. At the third station, three more tools rough-turn other surfaces on the hub, and a large drill cuts the center hole to partial depth. The periphery of the forging rim and its hub are further turned, and the bore depth is increased by drilling at the fourth station of the Mult-Au-Matic.

The hub of the compressor wheel is semi-finish turned and its bore core-drilled at the fifth station. Seven single-point, carbide-tipped tools, all mounted in one tool-block at the sixth station, are fed transversely to semi-finish face the hub shoulder, and rough-face the web and the rim flange. At the seventh station, the web, hub, and rim flange of the compressor wheels are finish-faced by means of six more single-point tools. The drilled center hole in the forgings is counterbored and chamfered, and the hub is finish-turned at the eighth, and final, station. About 1/8 inch of stock is removed per side in this operation.

The opposite side of the hub, rim flange, and web of the compressor wheel are contour-faced on the American hydraulic duplicating lathe shown in Fig. 2. The work is gripped on the periphery of its rim by means of a three-jaw scroll chuck, which is located against a thrust face on the opposite side of the hub and supported on the rim face. Two single-point, carbide-tipped tools, held in a square four-way tool-block, are employed to complete the contour-facing operation on the compressor wheel.

Movement of the tools is hydraulically controlled from a flat template. A hardened steel stylus, having a ball tracing point about the same radius as the nose on the tool, follows the outline of the template and allows metered amounts of oil from a tracer valve to enter a hydraulic cylinder attached to the tool-slide. In this way, movement of the cutting tool is controlled to reproduce on the work the contour of the template. In this contour-facing operation, one tool is used to cut the contour on the hub face and rim web, and chamfer the rim flange; the other tool faces a step in the rim flange, and then bores and faces the flange.

In a similar operation, a forged steel compressor wheel is contour-faced on the special New Britain cam-controlled, automatic chucking machine shown in Fig. 3. The forging is located on its hub bore and against the rim flange face, and is gripped by twelve air-actuated clamps that contact the outer face of the rim flange. In this set-up, four single-point, carbide-tipped tools are employed. Movement of all four tools is automatically controlled by cams to generate the desired profile on the hub, web, and flange of the compressor wheel.

An unusual operation performed on a compressor wheel is that of face, cylindrical, and bore grinding, all in one set-up. This is accomplished on the Bryant two-wheel, hydraulic grind-

Fig. 1. Forged steel compressor wheels for turbo-jet engines are rough-turned, faced, and drilled on eight-station Mult-Au-Matics.

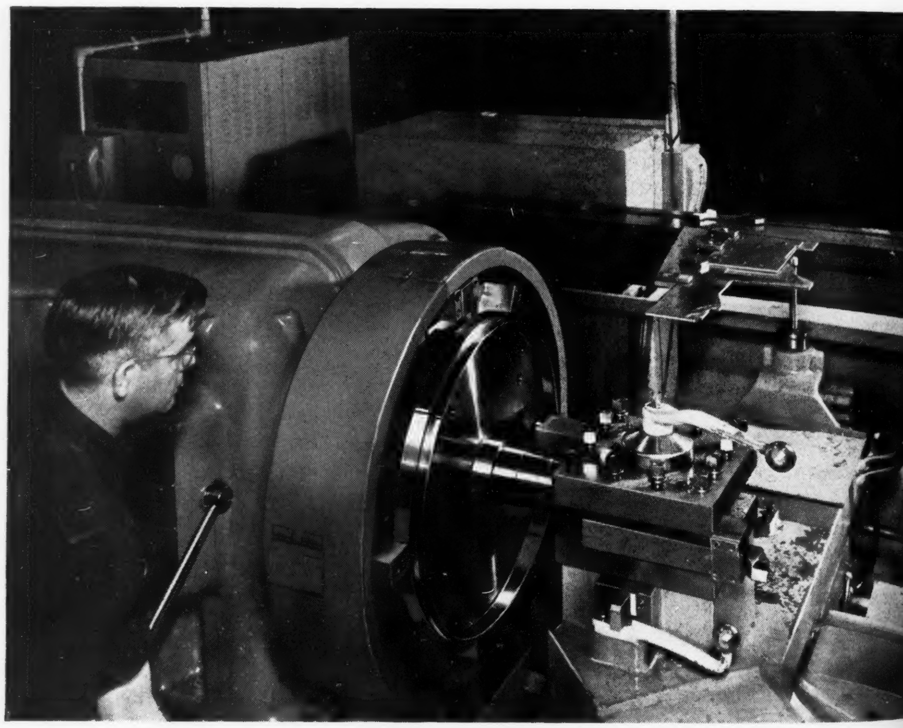


Fig. 2. Hub, rim flange, and web of the compressor wheels are contour-faced on this hydraulic duplicating lathe. Tool movement is controlled by a flat template.

ing machine shown in Fig. 4. Three flat surfaces —an external thrust face, the end face of the compressor wheel stem, and an internal thrust face—two external cylindrical surfaces, three internal cylindrical surfaces, and two radii are all ground on the one machine without changing the location or chucking of the work.

The forged steel compressor wheel is located on its previously turned rim flange bore, and clamped on the flange face. Vitrified-bond, aluminum oxide abrasive wheels of 60 grain size, K grade, and No. 5 structure are employed. The smaller wheel (for bore grinding) is 2 1/2 inches in diameter and is rotated at 9000 R.P.M., while the larger wheel, 8 inches in diameter, is rotated at 2400 R.P.M.

The compressor wheel is located on the hub bore and against the rim face in a special automatic, rotary indexing fixture designed by the Detroit Broach Co. for broaching dovetail slots in the periphery of the wheel. The fixture is angularly mounted to permit broaching the dove-

Fig. 3. In contour-facing steel compressor wheels, movement of the tools on this automatic chucking machine is controlled by cams.

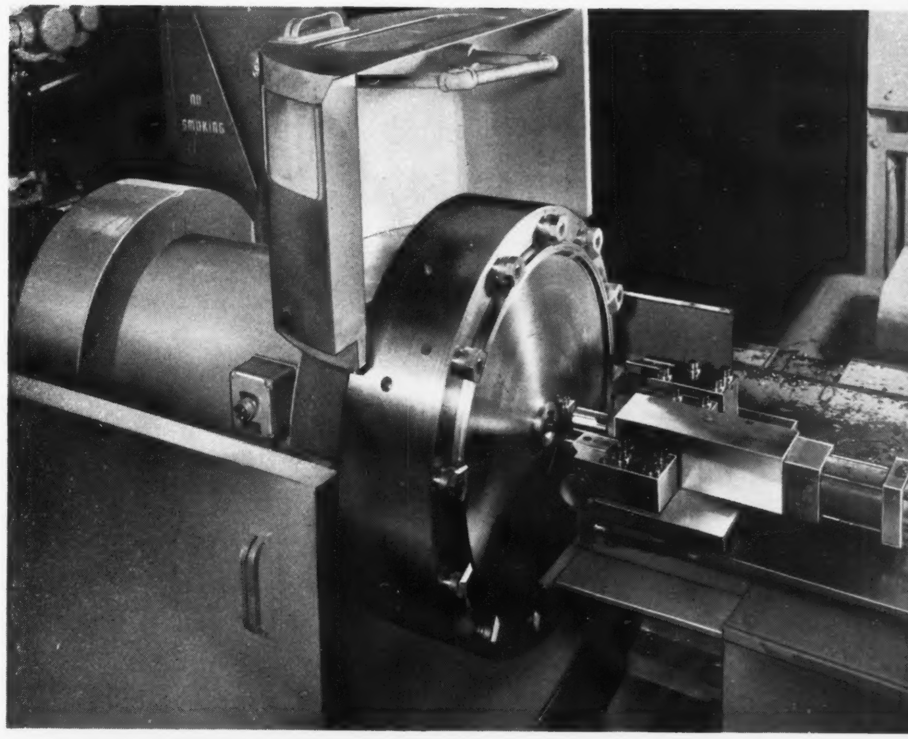


Fig. 4. Face-, cylindrical-, and bore-grinding are all performed in a single set-up on the double-wheel hydraulic grinding machine here shown.

tail slots at the required angle with relation to the compressor wheel axis. A cover plate equipped with a manually operated clamp is used to hold the work in the fixture. Automatic rotary indexing is obtained hydraulically, and automatic hydraulic traverse is provided for broach relief during its return stroke.

Grinding of the bottom surfaces on the rotor blade roots is accomplished on the Thompson surface grinding machine shown in Fig. 5. Five blades are ground at a time, the blades being located on the dovetail surfaces of their roots and held by means of a magnetic chuck. In assembling the rotor blades to the steel compressor wheels, Lubriplate is applied to the blade roots for lubrication, and the blades are tapped into place with a flat punch and hammer.

Production obtained in grinding the periphery of the blades on the compressor wheel assembly has been greatly increased by means of special

Landis cylindrical grinding machines, equipped with double work-heads. With this arrangement, one compressor rotor wheel assembly can be loaded or unloaded while another is being ground. Practically continuous grinding is therefore possible without any loss of production time for loading or unloading. A work-head is mounted at each end of the reciprocating table on the grinding machine.

Compressor stator vane rings of semi-circular shape are produced on Buffalo roll-forming machines. Two of these semi-circular rings are clamped together on the rotary table of a Bullard vertical turret lathe, and are faced, turned, bored, grooved, chamfered, and then cut apart to form four half-rings, or two complete stator rings when assembled.

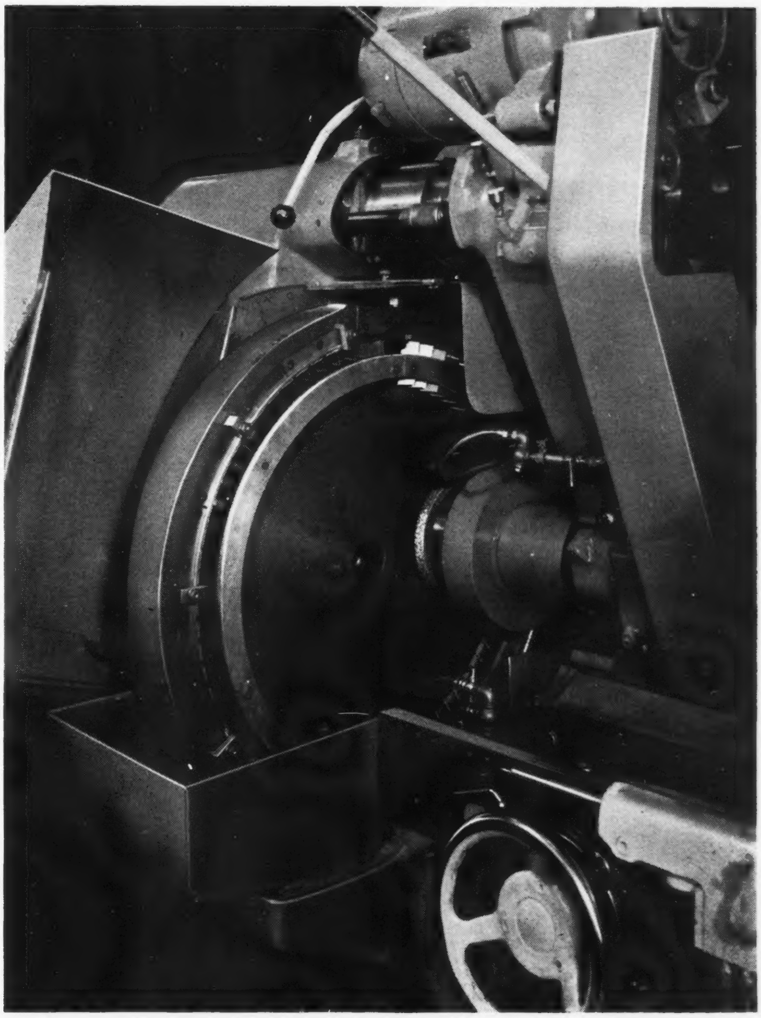
Dovetail slots for holding the vanes in the bores of the compressor stator rings are broached on American 10-ton, 54-inch stroke, vertical broaching machines. Since there would be little advantage in broaching a stator ring assembly (which would require indexing through a full 360 degrees), only a half-ring is broached at one time. The automatic, rotary indexing fixture is angularly mounted to permit broaching the slots at the required angle. In this set-up, the broach must pass within the fixture to cut the dovetail slots on the inner periphery of the stator ring, and provision has been made for automatically moving the tool away from the work at the bottom of the stroke so that the broach can be retracted and the work indexed.

After assembling the vanes to the stator ring halves in a manner similar to that employed in mounting the rotor blades to the compressor wheels, the vane tips are taper-ground on Bryant internal grinding machines, Fig. 6. Two halves are mounted together, locating on their outer peripheries and against their faces, and the assembly is ground in one set-up. The grinding wheel, which is rotated at about 6000 surface feet per minute, is automatically traversed past the work by cams.

Following milling of the split-line faces of the compressor castings, and then drilling, reaming, tapping, and lapping them, two compressor casing halves are assembled with forty-two bolts. The casing assemblies are rough-bored, faced, turned, and internally grooved on the Bullard Man-Au-Trol 54-inch, vertical turret lathe shown in Fig. 7. Previously machined chucking lugs and two drilled and reamed holes are employed to locate the casing assembly in the hand-oper-

Fig. 5. Bottom surfaces of the compressor rotor blade roots are ground, five blades at a time, on this surface grinding machine. The blades are held by means of a magnetic chuck.

Fig. 6. After assembling the vanes and mounting two stator ring halves together, the inner tips of the vanes are taper-ground by means of a cam-actuated grinding wheel.



ated fixture mounted on the rotary table of the machine.

The vertical turret lathe is equipped with both a left- and right-hand ram, and the hand-operated indexing turret at the lower end of the left-hand ram carries four single-point, carbide-tipped cutting tools, while the turret on the right-hand ram carries three. In the first operation on this machine, the tools on the left-hand ram are automatically fed to counterbore, face, and turn the flange at the upper end of the compressor casing assembly.

In the second operation, performed on the same machine without altering the location of the work, the grooving tool on the right-hand ram is employed to rough-form the upper four grooves, and then the grooving tool on the left-hand ram is used to rough-form the lower eight grooves. The blunt-nosed grooving tools must be fed in to depth, then up, and finally down to rough-form each groove. This feeding path is automatically controlled, as well as the repositioning of the grooving tools for cutting each successive groove. The third operation on the vertical turret lathe consists of chamfering and semi-finish boring and facing the upper flange of the compressor casing assembly.

All three operations, including loading and unloading, are completed in about one hour. A similar Bullard vertical turret lathe, also with Man-Au-Trol controls, is then employed to finish-bore, face, and turn the casing assemblies, and enlarge the grooves into T-slots. Again, the "in-up-and-down" motion and positioning of the cutting tools are automatically controlled.

Eight mounting pads on the periphery of the compressor casing assembly are drilled and tapped on a Natco special four-way, horizontal drilling machine (Fig. 8). Twelve holes are drilled in each mounting pad, the eight smaller holes being countersunk and then tapped.

The turbine wheel shaft and hub is turned and faced on LeBlond engine lathes—such as seen in Fig. 9—which are equipped with hydraulic tracer attachments. The part, located from the rear face of the forged hub, is chucked on the periphery of the hub and supported on a live center in the tailstock of the lathe.

A special compound rest is provided on the lathe for holding the hydraulic tracer attach-

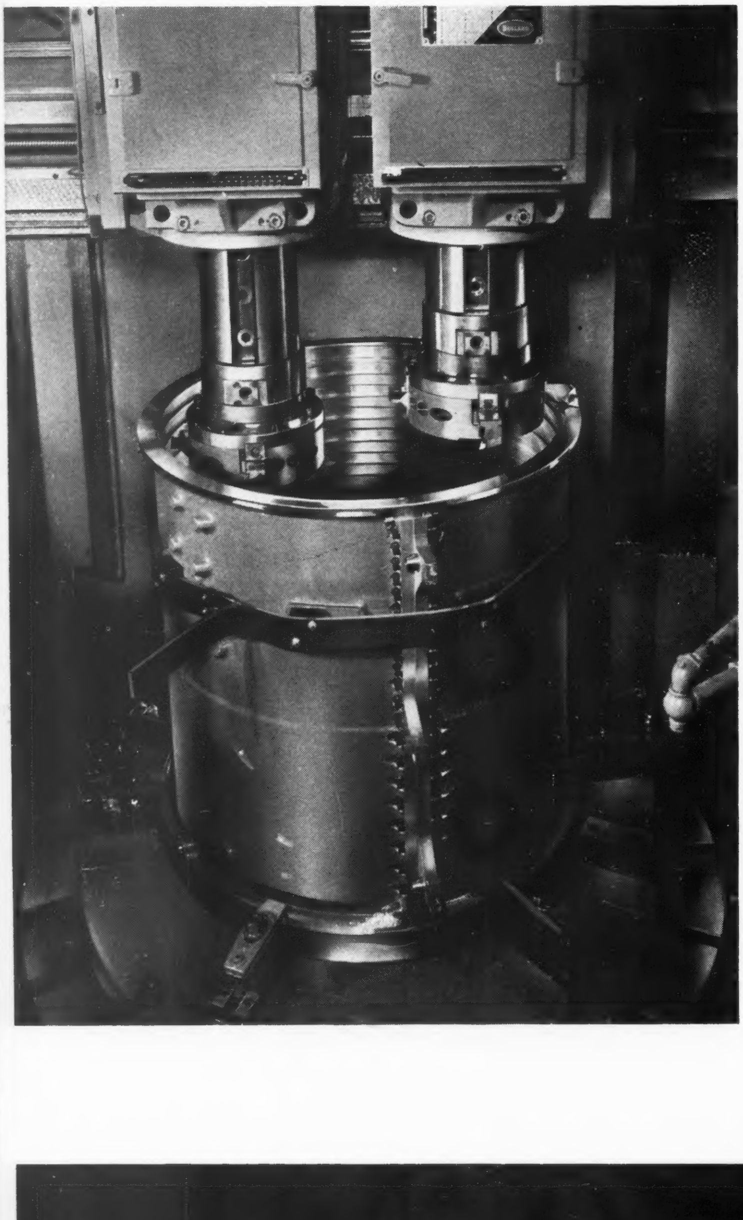


Fig. 7. Compressor casings for the turbo-jet engines are rough-bored, faced, turned, and internally grooved in a semi-automatic operation on this vertical turret lathe.

ment, and the flat template and controls are conveniently located on the front of the lathe. A template-actuated stylus controls a hydraulic metering device for moving the tool toward or away from the work.

The bore of the turbine wheel shaft is drilled through, from the solid, on the W. F. & John Barnes deep-hole drilling machine shown in Fig. 10. Carbide cutter blades are held in a spade-drill stem for this difficult core-drilling operation.

A rim that holds the turbine buckets around its periphery is welded to the hub of the forged turbine wheel shaft. Because of the high temperatures at which the turbine rim must operate, it is made of a corrosion- and heat-resistant steel. The rim bore and hub periphery are machined on both sides to form a modified double-vee groove, and a land is left on both the rim bore and hub periphery for locating in assembly prior to welding. A pigmented metal compound is brushed on both faces of the turbine wheel rim and shaft hub to prevent weld spatter from adhering to these surfaces.

All welds are made manually with General Electric 400-ampere, direct-current welding ma-

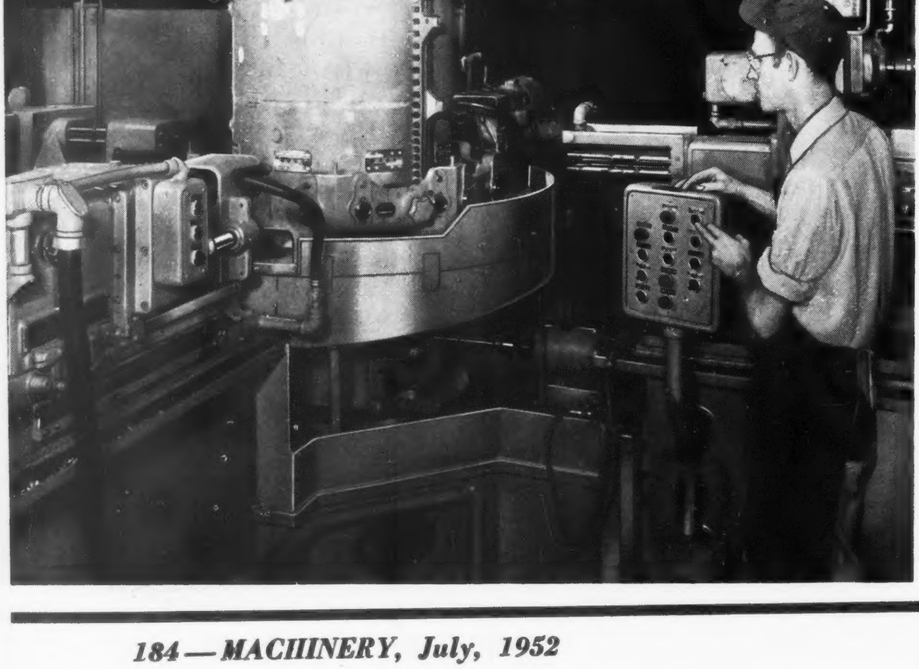
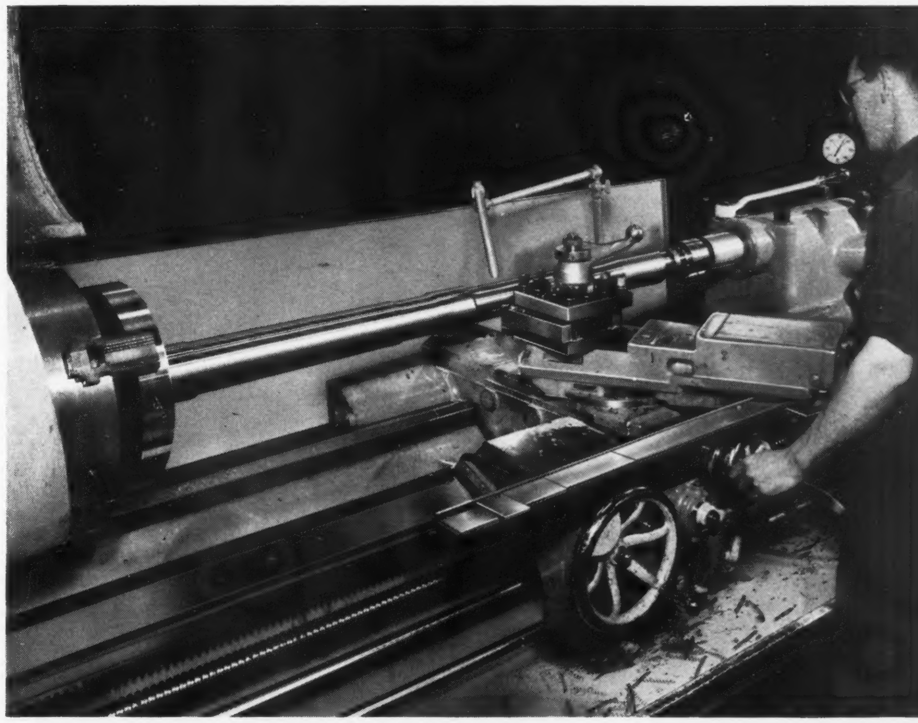


Fig. 8. A four-way drilling machine is used to drill and tap twelve holes in each of eight pads on compressor casing assemblies.

Fig. 9. Turbine wheel shafts are profile-turned and faced on an engine lathe equipped with a hydraulic tracer attachment. The flat template can be seen mounted on the front of the lathe.



chines, using reverse polarity and standard flux-coated ferritic electrodes. Four pairs of tack welds are made, one weld in each pair being diametrically opposite the other to distribute the stresses set up and to minimize distortion. A full length electrode is used for each tack weld. The tack welds are carefully cleaned of oxide, slag, and flux by means of portable pneumatic hammers equipped with chipping chisels and flexible shaft grinding machines provided with wire brushes and abrasive wheels.

Successive passes in the fourteen-bead pattern are welded progressively, with the wheel rotating clockwise on the power-driven positioner. After each pass, the weld is inspected for cracks, slag inclusions, etc., and any evidence of such defects is removed by grinding. Also, the fourth and all succeeding passes are peened. To minimize cracks, cold starts, and the need for cleaning, new electrodes are ignited as required in the arc of the used electrode so that a continuous pass can be made without stopping. Weld passes

Fig. 10. Carbide cutter blades held in a spade-drill stem are employed to cut a bore through the turbine wheel shaft.

Fig. 11. An air tracer profiling attachment is provided on this engine lathe for finish-forming the contour of the turbine shaft. The flat template can be seen at the lower left.

are made at the rate of about 3 inches per minute. The completely welded turbine wheel rim, hub, and shaft assemblies are stress relieved.

The welds on the turbine wheel and shaft assemblies are examined by both a 1,000,000-volt X-ray and fluorescent penetrant inspection methods. In the latter method, the assemblies are dipped in a fluorescent penetrant oil. Excess oil is washed from the parts, and they are then dipped into a "developer" tank containing finely divided powder in suspension. Capillary action of the oil draws these fine particles of powder to the surfaces of any cracks, and such cracks are then clearly visible when the parts are examined under black light.

The contour of the turbine shaft is finish-formed on a Monarch engine lathe, Fig. 11, equipped with an air tracer attachment. In this set-up, a flat sheet-metal template (seen at the lower left) having the desired profile to be duplicated on the work-piece, is scanned by a spring-loaded air tracer that operates on the air-gaging principle. Pressure established by the air tracer controls the operation of the tool-slide through a hydraulic relay valve that is actuated by bellows.

Ends of the broached slots in the periphery of the turbine wheels are deburred and rounded by wet-blasting in a Cro-Hone cabinet, Fig. 12, made by the Cro-Plate Co. In this operation, a fine abrasive suspended in water is blasted

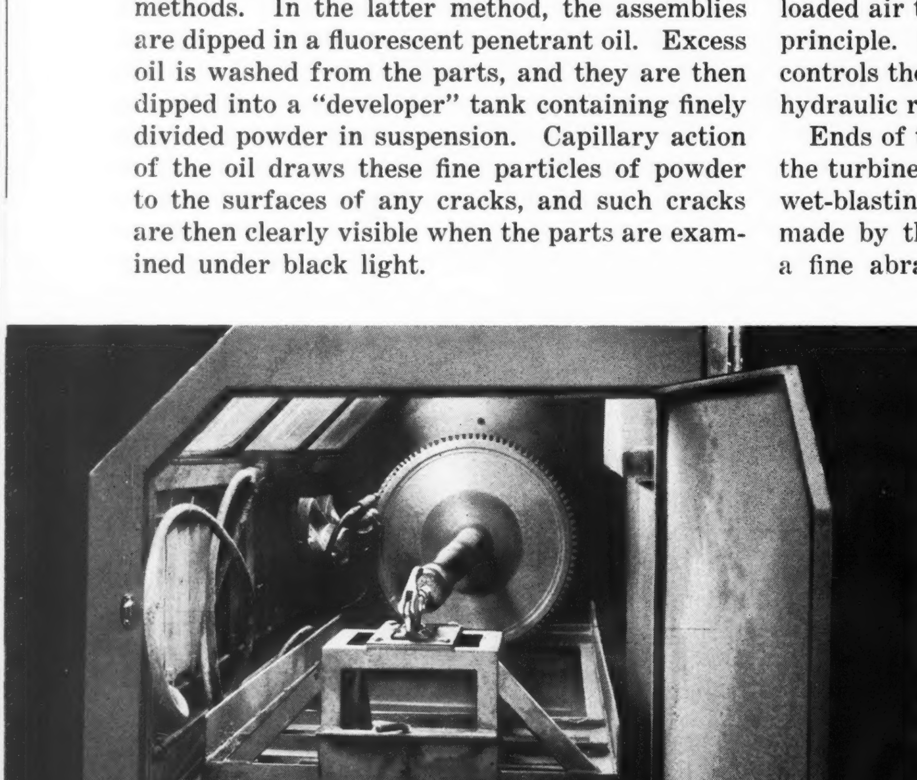


Fig. 12. Burrs are removed and the edges of the broached slots are rounded by blasting with a high-velocity abrasive solution.

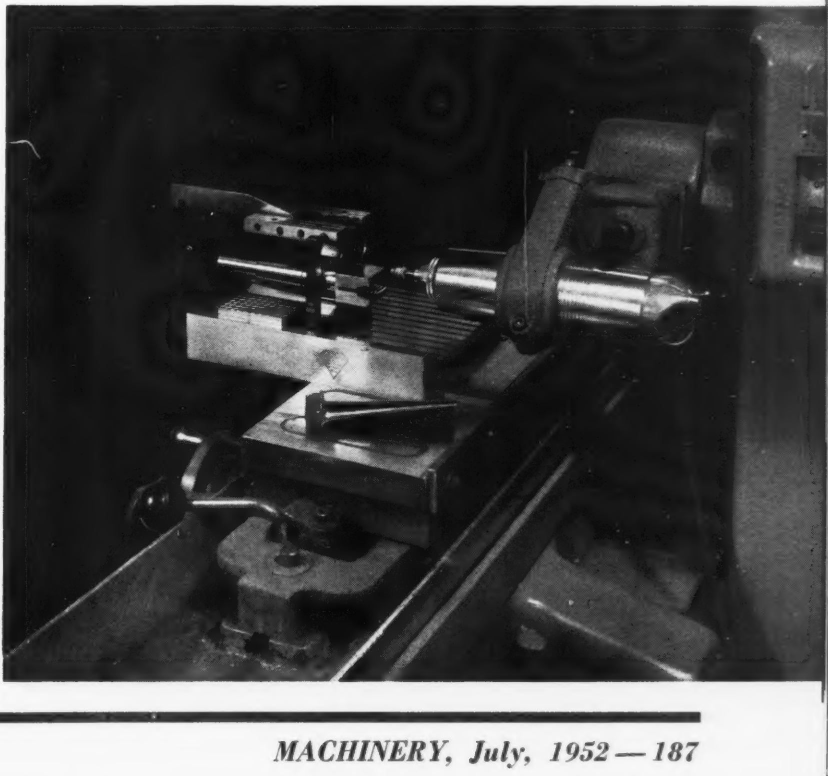
at high velocity against the work by means of a siphon jet gun held in the operator's hand. The loading door of the cabinet has been left open in the illustration to show the turbine wheel in position to be blasted. The pressure blaster, having no pump or other moving parts, operates on the shop air-line pressure in conjunction with an air ejector and a mixer gun to accelerate the abrasive solution to tip velocities as high as 1600 feet per second.

Turbine Blade Collets Formed with Portable Grinder

FACED with the problem of producing precision collets for gripping the serrated roots of turbine blades for airplane turbo-jet engines, engineers of Gem Tool & Die, Detroit, Mich., devised the unique set-up shown in the accompanying illustration. An electrically powered, high-speed portable grinder built by the Precise Products Co. is secured to the spindle housing of a standard horizontal surface grinding machine for this form-grinding operation, and the work is held in a special fixture on the magnetic chuck of the machine. The collets are made from an oil-hardening tool steel having a hardness of about 59 Rockwell C. Tolerance on the fir-tree shaped contour ground in the collet has to be maintained within $\pm$ 0.0001 inch. Measurements are made over 0.0481-inch diameter rolls.

After slitting and rough-grinding a V-shaped notch in one end, the work is clamped in the V-block fixture as shown. A vitrified-bond, aluminum oxide abrasive wheel of 100 grit size and K hardness is employed. Originally 3/8-inch in diameter by 1/2 inch long, the wheel is dressed to the desired shape by means of a "Diaform" wheel-forming attachment made by the Pratt & Whitney Division Niles-Bement-Pond Co. With this attachment, a 3/32-inch thick flat metal template made to an enlarged scale of 10 to 1 is used to control the motion of the dressing diamond through a pantograph linkage. After dressing, the outer end of the wheel is only 0.093 inch in diameter.

The portable grinder has an extremely accurate quill and collet chuck, and delivers 1/4 H.P. at the chuck. Speed of rotation is controllable between 15,000 and 45,000 R.P.M., and, for this particular operation, is set to operate at 40,000 R.P.M. From 0.020 to 0.030 inch of stock is removed from the rough-ground notch in this operation. The table of the surface grinding machine is slowly hand fed until the collet has been traversed past the grinding wheel, grinding top and bottom of the collet simultaneously in a plunge operation.



Electrical, high-speed portable grinder set up on a standard surface grinding machine for forming serrations in a collet. The collet grips the serrated roots of turbine blades for turbo-jet engines.

Spinning

NEARLY five years ago the El Segundo Division of the Douglas Aircraft Co., Santa Monica, Calif., decided to install its own metal-spinning department. Prior to that time, spun parts of various Navy airplane models had been supplied by sub-contractors. The decision to create the department was prompted by the considerable number of spun parts already being used, plus the knowledge that even more spun parts could effectively fulfill future design requirements.

Immediately after the spinning department began operation, additional uses for the equipment became apparent. One was to prepare blanks for the drop-hammer. In this application the work blank is spun to a neutral shape that somewhat resembles its finished contours, after which the part is finished under the hammer. The neutral and finished shapes of a typical part are shown in Fig. 1. Several important advantages accrue from this practice. First, fewer drop-hammer staging dies are required to produce the finished shapes because of the favorable displacement of the spun metal. Second, by directing the flow of the metal during spinning into the areas where it is required, severe drop-hammer draws are possible without excessive wall thinning. The result is that fewer parts have to be rejected because of ruptures.

Still a third advantage is the ability to fabricate in one piece many parts which previously had been made in several riveted or welded sections. The fuel-tank filler neck shown in Fig. 2 is a typical example. By spinning work blank A to a neutral shape B, it was possible to make the deep drop-hammer draw required to produce filler neck shape C in one piece. A step in the transition of the work blank to the finished part is shown in Fig. 3, with the neutral shape in position over one of the stationary die members in a rope drop-hammer. By again referring to Fig. 2, the completed spun part D can be compared with part E, which was made by welding together two sections F and G.

g Precedes Forming at Douglas

Douglas A2D Skyshark

By
H. W. SNOOK
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Two of many other examples of the spinning process are shown in Fig. 4. A switch box previously made of several assembled pieces, as at *A*, is now formed from a neutral spun shape *B* into the finished shape *C*. A nose fairing section *D*—which was made by welding together two mating sections *E*—is now spun from a blank *F* to a neutral shape *G*, then formed as at *H*, and trimmed as at *J*.

Where aerodynamic segments of high length-to-diameter ratios are desired, the spinning is done in stages, for each of which a breakdown chuck is needed. Over a period of time, so many shapes have been developed that the forms for many of them serve as suitable breakdown chucks in other applications.

Fortunately, the establishment of the department came at the same time as an increasing demand for aircraft structural shapes suited to fabrication entirely by spinning, such as fuselage sections and engine nacelles, as well as externally carried streamline packages, known as pods,

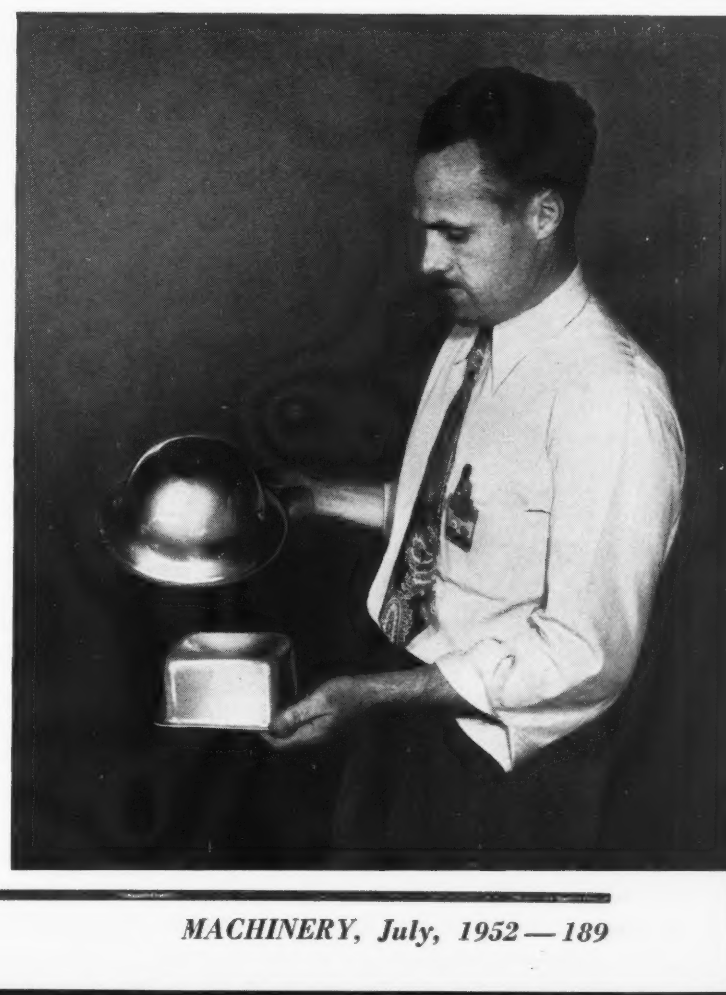


Fig. 1. This view shows a part in the neutral shape after spinning and in the finished shape after forming under the drop-hammer.

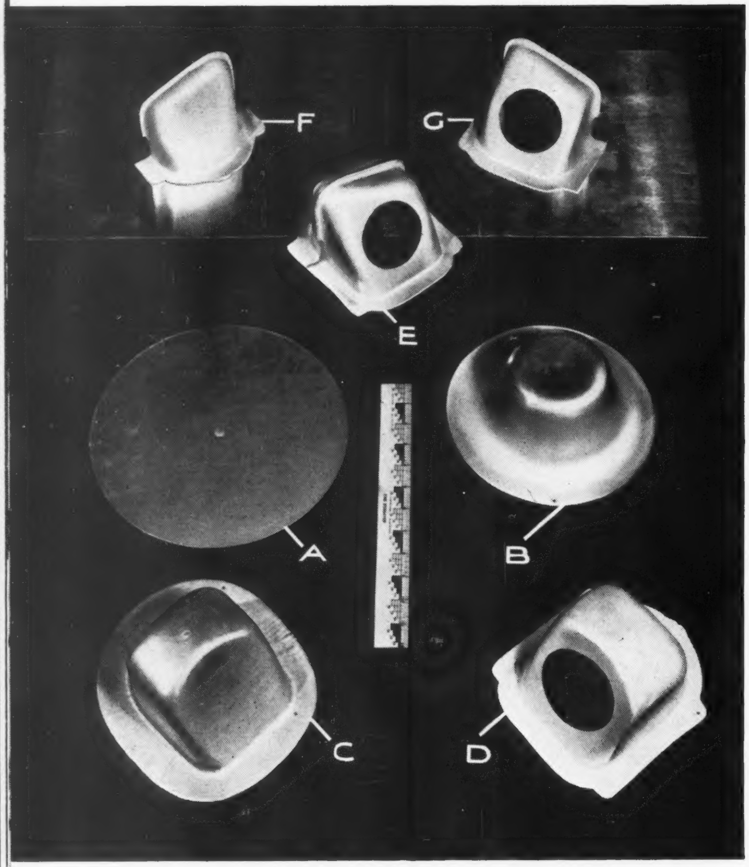


Fig. 2. Comparison of the welded fuel-tank filler neck (E) with the one-piece spun filler neck (D)

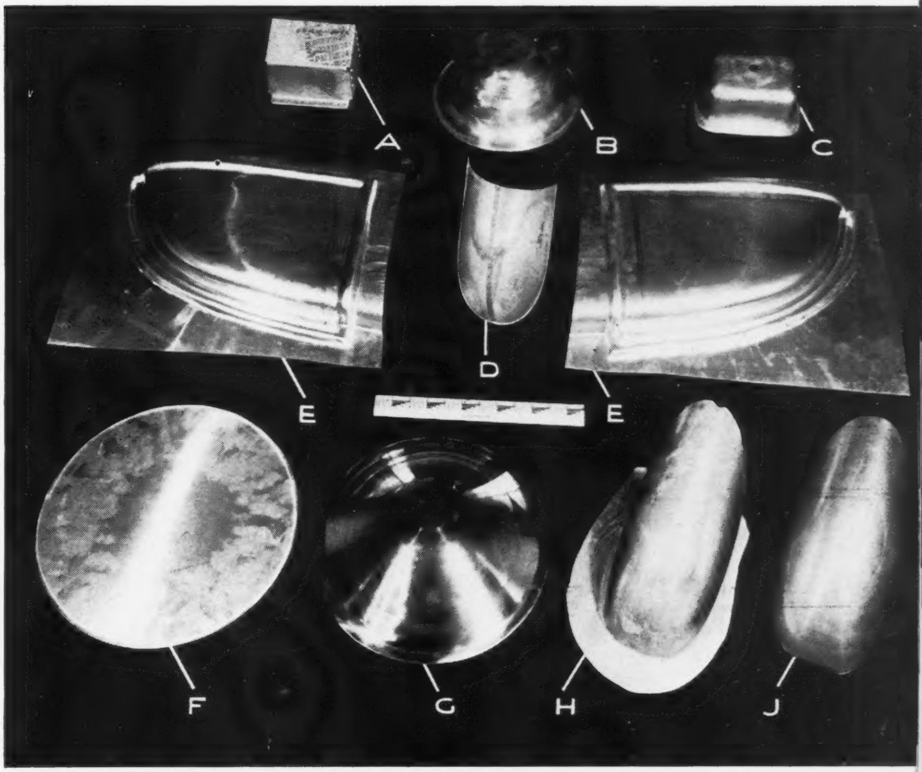
which accommodate electronic gear, fuel tanks, and other airborne ordnance. Many of the pods —wing-tip fuel tanks, for example—are expendable, and must be economically produced in large quantities.

The initial development of each of these new spun envelope type sections has involved structural problems not unlike those encountered with the basic airframe. Strength members and load points must receive proper consideration, and of equal importance is the necessity to obtain aerodynamically good lines. This last-mentioned requirement is best met by shapes that are circular in cross-section—which, incidentally, lend themselves ideally to spinning. Longitudinal, or line-of-flight, profile is rather readily modified for ease of production. Furthermore, it is generally possible to reduce the number of component parts in a pod assembly when they are to be spun rather than to be formed in a press, thereby holding objectionable joints to a minimum. A group of spun tail-cone assemblies is shown in Fig. 5.

In order that the streamline outer surface of the pod will be perfectly smooth, the segments of the pod are interlocked by spinning a short step, or nest, at one end of each segment, as can be seen in Fig. 6. When assembled, each step engages and automatically aligns the plain end of the adjacent segment. During the spinning, a short wall is left next to each step, creating an integral frame for the pod. Permanently attached segments are spot-welded or riveted together.

Fig. 3. One step in the transition from blank to finished part. The neutral shape of the filler neck in position on rope drop-hammer

Fig. 4. Switch box (C) and nose fairing section (J) are now spun and drawn from a single piece on a production basis. These parts were formerly welded, as shown at (A) and (D), respectively.



Where disassembly of the segments may be required, they are held together with flush type screws.

The metal-spinning department has still another function—it enables engineers to solve design problems inexpensively in a matter of hours. Design objectives are constantly being evolved, and many sample parts are spun for proving. New Venturi shapes, for example, must be subjected to a functional check before a manufacturing technique can be approved. Before spinning facilities existed, experimental models were a costly proposition, and it was often necessary to make a compromise in a design to eliminate a lengthy delay. Today, these prototype parts and parts in production quantities are being spun

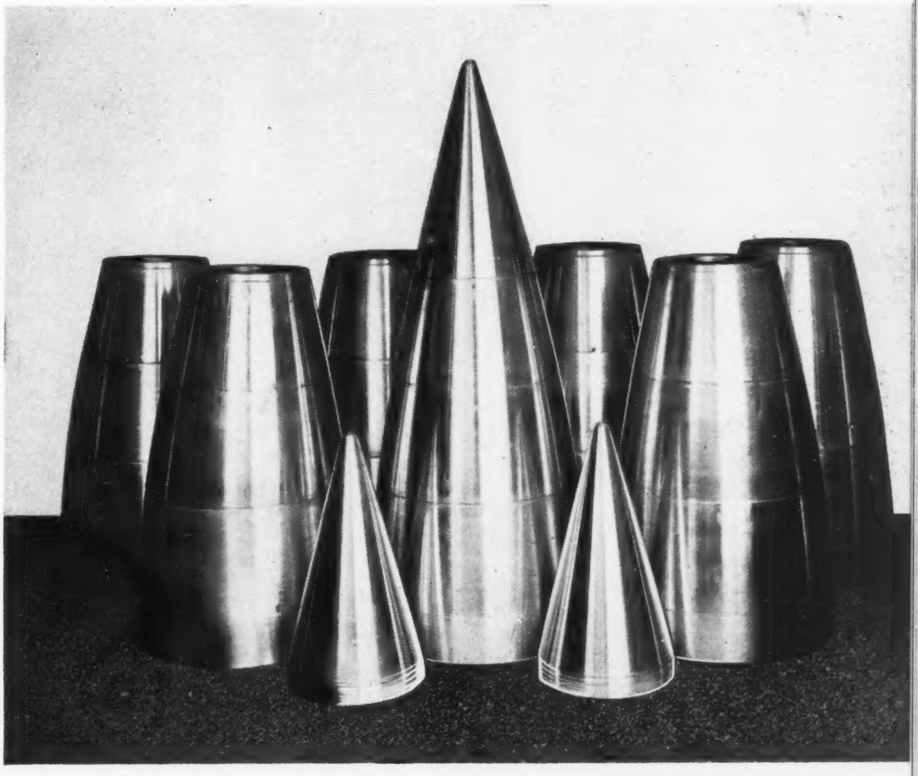


Fig. 5. These spun nested segments of tail-cone assemblies are ready for the production-line spot-welding operation

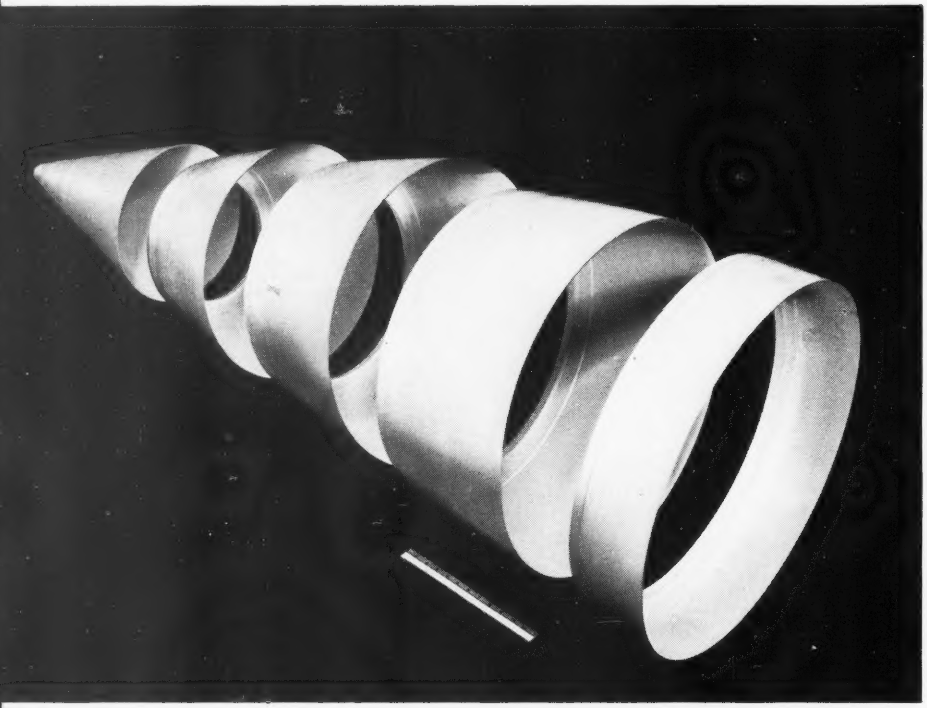


Fig. 6. A wall spun next to the step of each segment provides an integral frame for assembled pod.

side by side. Typical experimental spinnings are illustrated in Fig. 7.

At the start, the equipment of the department was quite modest, the spinning being performed on conventional wood-turning lathes. As the need for the process grew, regular spinning lathes were added. Just recently, several large-capacity production spinning lathes were installed to accommodate blanks for some of the larger pods.

From time to time, problems have taxed the ingenuity of engineering and shop personnel. One problem was the excessive pressures required for spinning some of the heavier gage metals. Undue effort was demanded of the operator when the ordinary leverage type spinning tool was used, so an ingenious booster, shown in both Fig. 8 and the heading illustration, was devised. All necessary spinning pressures are hydraulically sup-

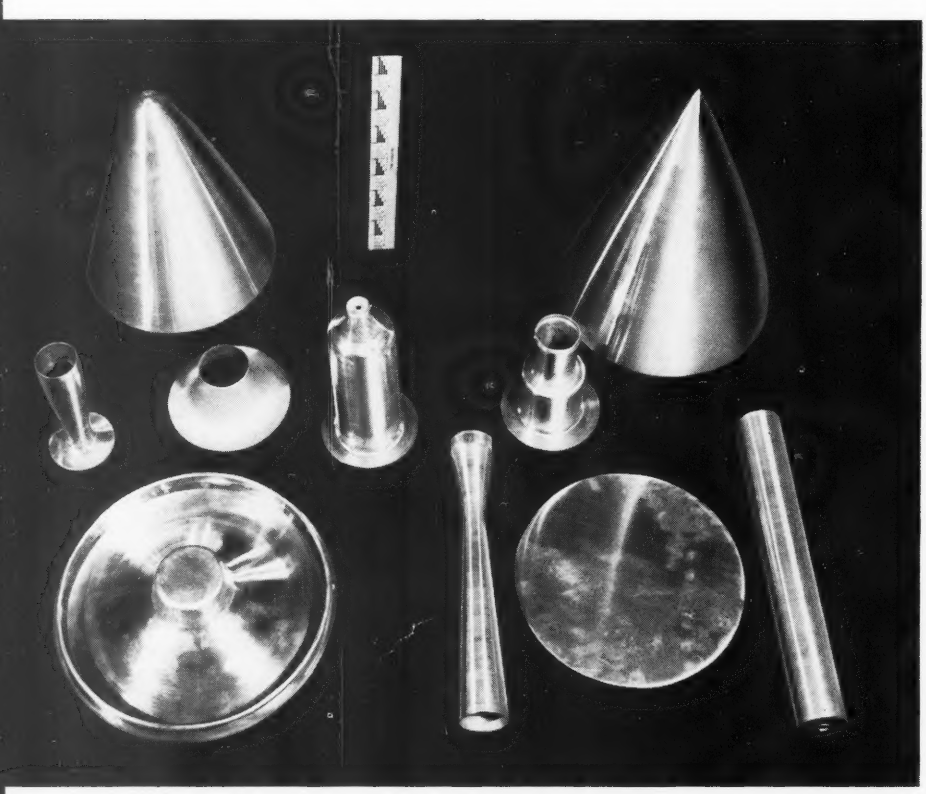
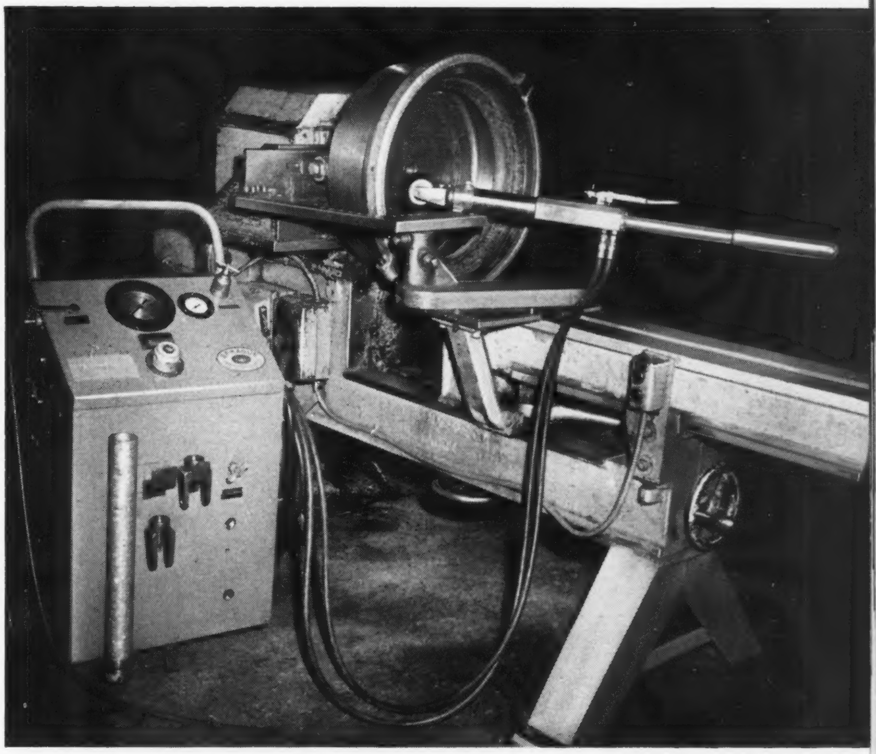


Fig. 7. The experimental parts here shown have been economically produced by metal spinning.

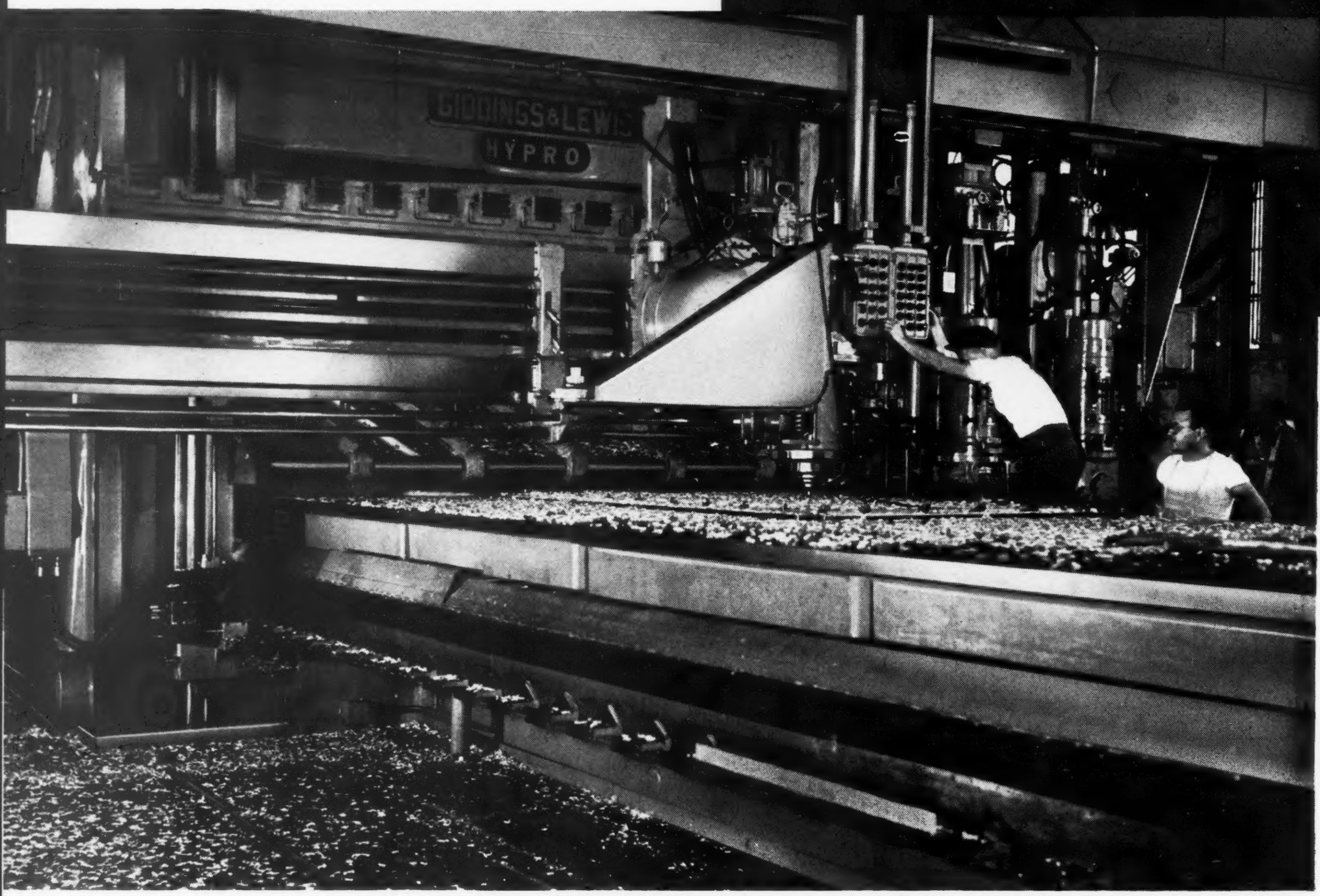
Fig. 8. *This novel hydraulic booster tool supplies spinning pressures for heavier gage metals.*



plied by this tool, yet the sensitivity for the operation is still retained in the hands of the spinner. Another problem has been the accurate reproduction of chucks, with no more than the loft-line template information to go by. A novel tracer attachment is currently being developed which will duplicate such templates with speed and accuracy heretofore unobtainable.

Spinning operations continue to be largely an art. In few, if any, other metal-working operations is the quality of the product so dependent on the experience and skill of the worker.

Producing



By R. B. SCOTT, Supervisor
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IN the relatively few years since the war, revolutionary changes have been made in the design of fighters, bombers, and transport aircraft. Today's planes fly at speeds two to three times faster than the planes of 1942. Equipment and cargo requirements, as well as flying range, have been increased. The cruising or flying range, especially, has become more important than ever before. Present performance requirements have created important changes in the theory of structural design.

Modern aircraft must withstand tremendous increases in dynamic and static wing loading, despite the dictates of aerodynamics which have made reductions in wing thickness necessary. From a production viewpoint, it has been found impractical to employ conventional methods of assembling to achieve the required aerodynamic smoothness necessary for the new high performance wings. Progress in the solution of this problem has been made, however, by adopting an entirely different design theory in developing these wings.

As a result of the performance requirements of modern aircraft, the designer is confronted with a paradoxical problem in which the space and load-carrying capacity for cargo and fuel must be increased whereas the possibilities of obtaining these characteristics with thin wings appear to diminish. This problem became apparent to Lockheed engineers some years ago, with the result that a new theory of structural design was evolved, based on the use of integrally stiffened panels. A typical structural member embodying this design consists of a one-piece aluminum panel with ribs, stiffeners, reinforcements, attaching edges, etc., machined, forged, rolled, or extruded integrally with the outer or skin layer. (By way of contrast, a comparable sheet-metal fabricated panel is comprised of hun-

Integrally Stiffened Skins for Jet Fighters and Constellations

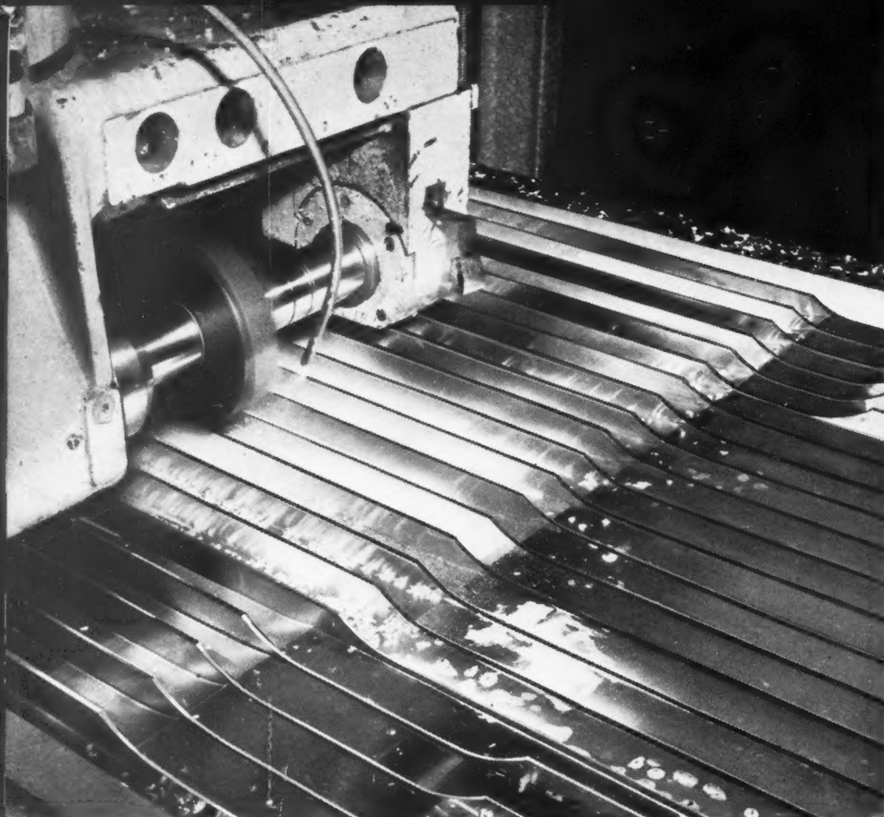
dreds and even thousands of stringers, clips, and doublers riveted to a sheet metal skin.)

The advantages to be gained from the integrally stiffened type of structure are manifold. From a performance point of view, the panel can be designed and manufactured so that every ounce of metal carries the proper proportionate load with the maximum efficiency. A structure is produced in this way which bears the increased stresses of high performance flight with minimum weight. By the same token, integrally stiffened structures will handle the lighter loads of more conventional designs at an actual saving in weight.

From an aerodynamic standpoint, it is obvious that a one-piece panel can be produced to a high degree of surface smoothness—which is an important factor in all aircraft and mandatory when high performance and extreme speeds are required. In addition to these advantages, wings employing integrally stiffened panels are characterized by the absence of conventional sheet-metal ribs, struts, bulkheads, and other space-consuming structures. It is apparent, therefore, that what little space remains in the thin wing, is available for equipment or fuel.

After several years of research and testing, the Lockheed Aircraft Corporation has succeeded in applying the theory of integrally stiffened structures to actual production. All aircraft manufactured by this firm employ, either partially or completely, integrally stiffened wing covering. The process of reducing this material to a production part has resulted in the investi-

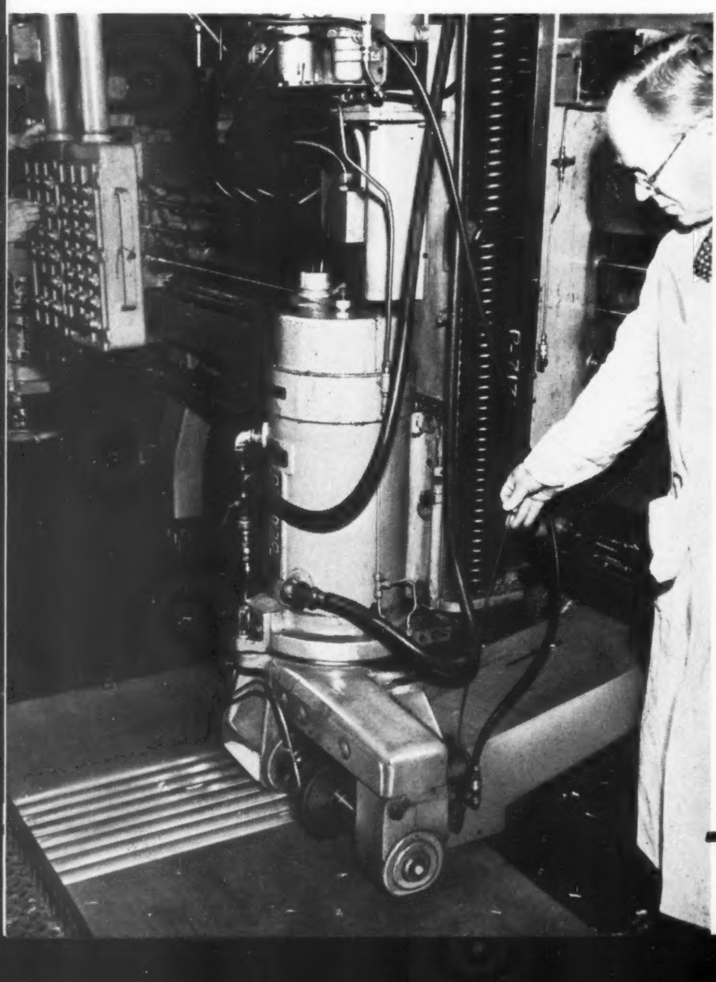
Milling integral stiffening ribs in aircraft skin employing a Giddings & Lewis Hypro skin milling machine



Close-up view of milling operation on integral stiffening ribs for aircraft skin

gation and adoption of numerous manufacturing processes.

An important advantage resulting from the use of integrally stiffened skins has been found to be the considerable savings in the over-all manufacturing cost of wings. Three or four large panels instead of thousands of small sheet-metal pieces can naturally be handled with a great reduction in assembly labor and tooling. But in addition to this, an even greater reduction has been experienced in tooling costs. For example, one moderate sized integrally stiffened panel replaces some 900 small sheet-metal parts requiring the use of a great many template form blocks, blanking and piercing dies, forming dies, etc., not to mention the labor required to produce them. These factors more than compensate for increased costs of machining the integrally stiffened panels.

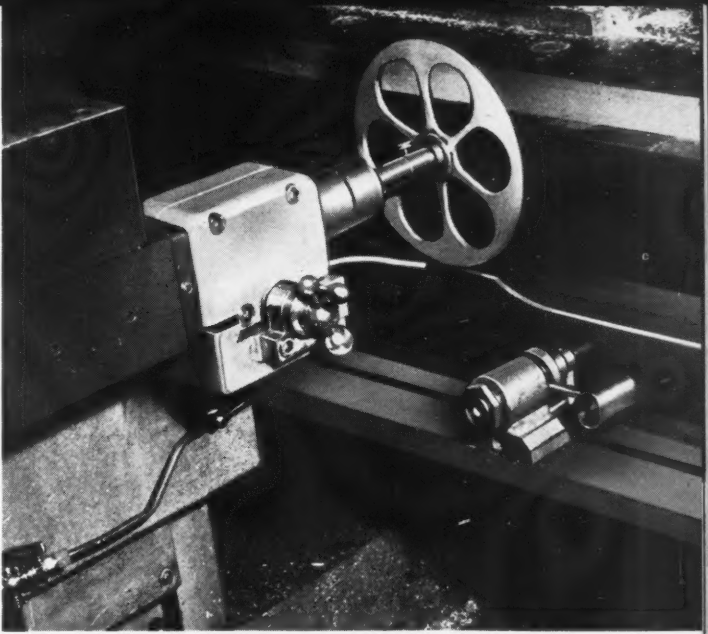


Means have been developed for producing integrally stiffened panels by machining from plate, by extruding, by forging, and in some instances, by casting, depending upon the thickness, over-all size, and complexity of the panels. At the present time, the forged and cast types are in their infancy, and greater dependence is placed on machined and extruded panels. It is expected, however, that casting and forging will ultimately become competitive processes for the production of the basic material.

The extrusions now being produced are limited in width to approximately 27 inches and in length to about 90 feet. These panels are sometimes employed as extruded, while in other cases some machining operations are performed to taper the skin thickness between the ribs or to generate other special forms or shapes. However, for the larger sizes and more complicated panels—such as the 4-foot by 32-foot lower wing skin used in the Constellation transport—it is still necessary to machine these panels from solid plate. In order to carry out the heavy machining

Horizontal cutting head of Hypro machine equipped for machining integral stiffening ribs of aircraft skin

"Rise and fall" cam that controls depth and pattern of integral rib cutting operations on aircraft skins and panels



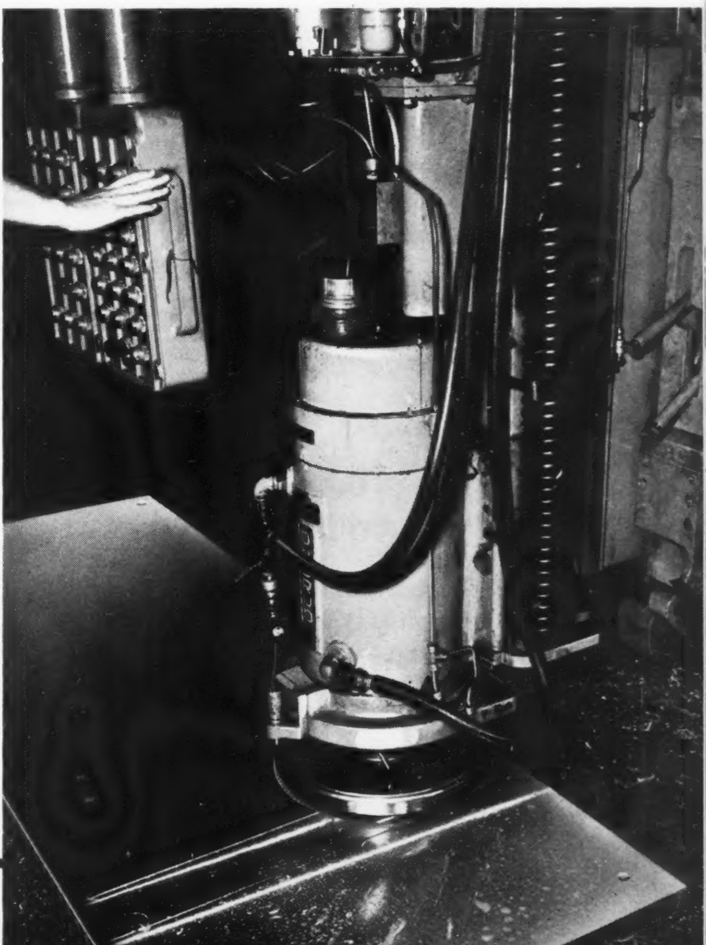
program necessary for the production of these two types of integrally stiffened skins, Lockheed, in collaboration with the Giddings & Lewis Machine Tool Co., developed and built the special skin miller seen in the heading illustration. This equipment will handle plate stock 10 feet by 34 feet and up to 2 1/2 inches thick. Every effort was directed toward producing a machine which could be operated at high production rates.

To this end, part configuration is controlled by both General Electric and Cincinnati Hydro-Tel types of tracing mechanisms riding on "cam packages" containing as many as twelve separate cams. The control mechanisms continuously govern the motion of three 100-H.P. cutting heads which may be swiveled to cut ribs both parallel to and across the table. Cutting speeds and feeds are incorporated to utilize the latest developments in high-speed milling techniques. A special feature is the conveyor-belt chip disposal system, capable of handling the chips resulting from the removal of as much as 900 cubic inches of metal per minute. Chips in this case are conveyed directly to hoppers outside the building and to waiting trucks.

Fabrication shops are also faced with unique forming problems, since the machined or extruded material has to be formed to the correct aircraft contours. A good part of the equipment purchased by Lockheed for its "Hall of Giants" (described in July, 1951, MACHINERY), was developed with these forming problems in mind. This equipment includes drawing, stretching, and other machines of exceptional capacity, as well as the giant size Hypro machine shown in the accompanying illustrations. From a stress standpoint, integrally stiffened skin designs fall into two categories—those in which the ribs are approximately parallel to the wing, and those with ribs approximately parallel to the fuselage.

For skins in the first category a shot-peening technique was developed and a special machine produced which will handle panels 4 feet by 34 feet. Machined or extruded panels are passed through this apparatus and shot-peened on both sides, the intensity of peening being adjusted to produce the degree of curvature desired. Shot-peening serves to improve the surface properties of the metal and reduce stress corrosion.

The other category of integrally stiffened skins, in which the ribs are disposed across the wing, generally requires a greater amount of forming. Furthermore, the varying section modulus of the part along the ribs imposes severe forming problems. However, a stretch-forming technique has been developed employing highly specialized stretch-forming tools that control the flow and distortion of the rib panel. This treatment results in completely formed leading edges and upper and lower contoured panels. Lighter skins of this kind are being formed at the present time in a large 1500-ton double-action press, but a special high performance Birdsboro press of 8000-ton capacity has been installed to handle the bulk of integrally stiffened panels.



Close-up view of vertical head of skin miller machining integral stiffening ribs in aircraft skin

PRECISION parts for General Electric Co.'s powerful J47 turbo-jet aircraft engine are subjected to internal temperatures above 1500 degrees F., rotative speeds of 8000 R.P.M., and the flow of 6000 pounds of air per minute at speeds above 1200 miles per hour. To withstand the terrific stresses set up, the parts must be manufactured to extremely close tolerances.

Rapid adaptation of turbo-jet engines to existing and new designs of military aircraft and our current rearmament demands have greatly accelerated production requirements. Equipment and methods employed at the Lockland, Ohio, and Lynn and Everett, Mass., plants of the General Electric Co. to meet the rigid inspection standards on a high production basis will be described in this article.

Receiving inspection is a very important phase of quality maintenance, especially when it is realized that raw materials and parts for the axial-flow turbo-jet engine are received from several hundred sub-contractors and suppliers. Incoming raw material to be used for parts manufacture is held in areas specially designated for unreleased material until it has been determined that both chemical and physical requirements are satisfactory. All material to be used for manufacturing purposes can only be drawn from predesignated released-stock areas. Identification is essential for several vital materials that require welding, heat-treatment, or plating.

Details of parts furnished by sub-contractors or suppliers are checked for quantity and physical condition, and then inspected for specific items listed on detailed Inspection Procedure Sheets. Products from new suppliers or new products from present suppliers are subjected to a "first-sample" approval. An inspector is shown in Fig. 1 checking the dimensions of a new solenoid-operated, air shut-off valve. The parts are also given an operational test and a complete teardown for internal inspection. After first-sample approval, it is only necessary to check all characteristics of such parts periodically.

In Fig. 2 are seen several of the hydraulic test stands employed to check the required operating characteristics of turbo-jet engine accessories. Each stand can be used to test from one to four different accessories at the same time, which are given some form of operational test prior to delivery to stock-rooms. The results of such tests also play an important part in the development of new parts or the modification of existing accessories.

Turbo-jet Engine Inspection Seeks Perfection

North American F-86 Sabrejet

By L. N. CIMINI and D. C. BROWN
Aircraft Gas Turbine Inspection Division
General Electric Co.

The inspection of parts manufactured within the Aircraft Gas Turbine Division of the General Electric Co. is accomplished either by progressive inspection methods or by final area inspection, which is often supplemented by some progressive or process inspection. In the progressive inspection system, the parts are inspected immediately after each manufacturing operation. For example, a mid-frame section for the turbo-jet engine is shown being inspected in Fig. 3, immediately following boring, turning, and facing operations performed on a vertical turret lathe seen in the background. The inspector is using outside calipers to check the flange diameter of the mid-frame. Shown in the foreground at the right is a mobile inspection unit which carries the blueprint and operating sheet for the workpiece, and the various "Go" and "No Go," caliper, plug, and dial indicating gages necessary for the inspection.

A benefit derived from progressive or process inspection is that defective work is indicated at its source. Thus more immediate corrective action is possible and expensive subsequent operations, needlessly performed on already defective parts, are eliminated. In this type of inspection, however, extreme care must be exercised to insure that any dimension which may be affected by a subsequent operation is re-inspected after that operation.

In final-area inspection, the completed parts are moved to designated locations for inspection. Detailed Procedure Sheets, which list the dimensions and properties to be inspected, and the gages to be used, are rigidly adhered to in such inspections. The dimensions to be inspected will depend upon their importance in the end-product application. The sampling plans used in checking these properties and dimensions are patterned after MIL-STD 105A, and have been approved by the United States Air Force.

For this program, it has been necessary to determine the specific dimensions and properties of each part that are classified as critical, major, or minor. Critical characteristics are those that could result in conditions hazardous or unsafe for personnel operating or maintaining the equipment. Major characteristics could materially reduce the usability of component items, while minor dimensions or defects have little or no effect on the manner of operation.

Many parts for the turbo-jet engines have all three characteristics. It has been found that so-called critical parts have only a relatively few

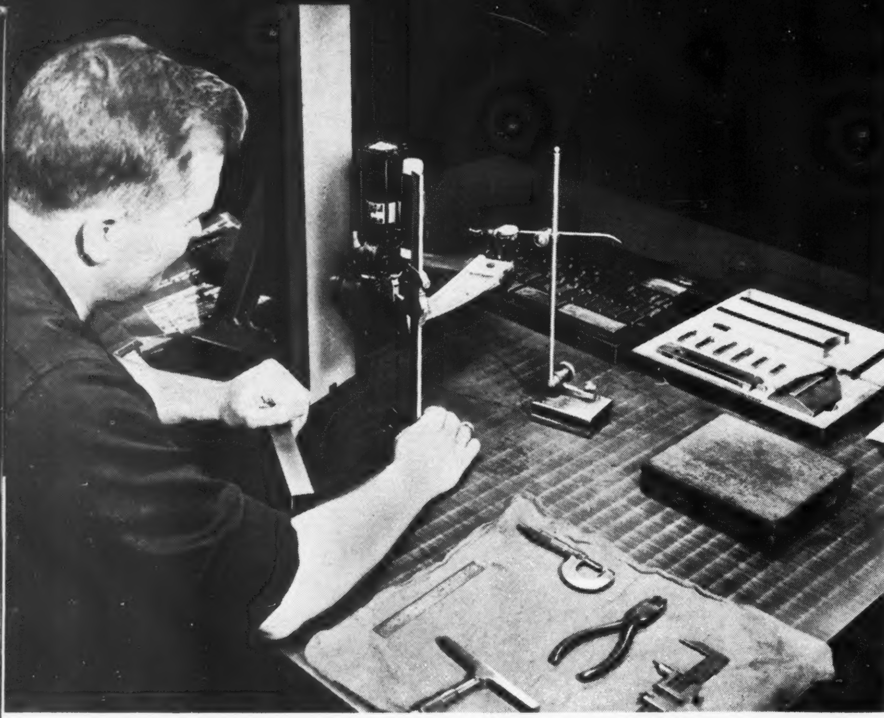
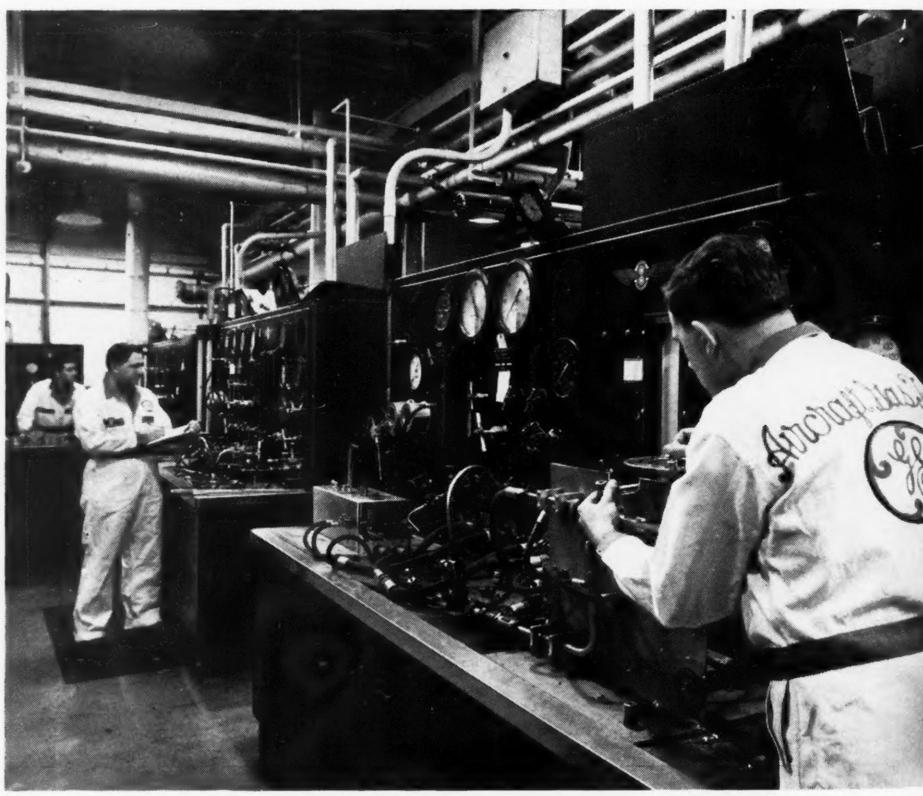


Fig. 1. The dimensions of a new solenoid-operated, air shut-off valve are checked to obtain "first-sample" approval.

Fig. 2. Accessories for turbo-jet engines are given tests simulating operating conditions on these hydraulic test stands.



dimensions or properties that actually control the critical nature of the parts. Such critical dimensions or properties are given the maximum possible inspection, while major characteristics are usually sample inspected in accordance with a rigid plan. Less rigid sampling is required for minor characteristic inspection.

An unusual final inspection area is shown in Fig. 4, where the turbine buckets are inspected on a conveyorized set-up. Tote-pans containing sixty-four buckets are conveyed past the inspectors, each of whom checks from two to four dimensions or properties. The seven critical dimensions are examined on all sixty-four buckets in each pan. For major dimensions, twenty-five parts are selected to rate each pan, while for minor dimensions only fifteen parts are inspected. Each pan of buckets is given a number, and if the number of defective pieces in any sample exceeds the permissible quantity, the whole lot is returned to the shop. Defects at the first inspection are recorded for subsequent reference. When re-submitted for inspection, only those dimensions that caused rejection are re-examined.

Another of the many final inspection areas is shown in Fig. 5. The inspector on the right is checking the various dimensions of the air ex-

Fig. 3. A mid-frame section being inspected immediately following boring, turning, and facing on a vertical turret lathe

Fig. 4. Conveyorized set-up is used for inspecting turbine buckets. Each inspector checks from two to four dimensions or properties.

traction pads of the compressor, while the man on the left is using a power-operated thread-gaging head to inspect the tapped holes in these parts.

General Electric is constantly experimenting with new and improved inspection tooling. Several well-known manufacturers of such equipment have active programs in process, and many of their products are being studied and evaluated. One example is the special gage used for final inspection of compressor blades for the turbo-jet engine. This high-production gaging instrument has an "Airechart" for checking the contour, thickness, tilt, and angle of the compressor blades at eighteen points simultaneously.

A specially designed fixture for inspecting the concentricity of external bearing surfaces with relation to the bore of turbine wheel assemblies is shown in the heading illustration. The assembly is placed in the fixture with its bearing surfaces resting on half-round bronze bushings, and is rotated by a friction-driving roller from an electric motor. Dial indicating gages (not shown) are employed to check the concentricity of the bearing surface diameters, and then the electronic gage is used to inspect the concentricity of the bore at seven locations, 6 inches apart.

As is customary in the manufacture of other types of aircraft engines, assembly of the turbo-jet engines consists of a "green run" assembly

Fig. 5. Final inspection area for air extraction compressor pads. Inspector at left is using power-operated thread-gaging head.

and final assembly, with teardown and re-inspection of components performed between the two assembly operations. The inspection process is of a progressive nature with operational tests for performance as the final step.

Engines are first assembled on the green run build-up line, and are checked in accordance with Inspection Procedure Sheets. Certain entries are made during this initial build-up into a historical engine record which is kept with the engine throughout the assembly. After this initial build-up, the engine is checked for fuel or lubricating oil leaks on a special test stand. High-pressure oil is circulated through the system to simulate operating conditions. With the exterior surfaces of the engine wiped free of oil, they are then visually inspected for leaks. This procedure insures against possible costly delays during subsequent operation in the test cells due to leakage.

Special heat-resistant and sound-muffling cells are employed for operational testing of the turbo-jet engines, which are supported off the floor by cradles. Air enters the axial-flow engines at 100 miles per hour and is exhausted at from 1300 to 2000 miles per hour. The "floating" control rooms for such test cells are completely isolated by being suspended on rubber and cushioned by air. Standard instrumentation in the cells consists of electrical circuits for electronic and electrical engine control, temperature measuring circuits for exhaust gas and ambient temperatures, and other measurements such as rate of fuel, oil, and air flow; thrust; pressures; and the speed of rotating parts.

Running from each engine under test to the control room are several hundred electrical leads for electronic and electrical control of the engine and for special instrumentation. Instruments

Fig. 6. Elaborate instrumentation is provided in the control room of the test cells to indicate or record clearances, temperatures, pressures, speeds, etc.

Fig. 7. Compressor rotor assemblies are dynamically balanced to within 0.6 ounce-inch both before and after the green run.

in the control rooms, one of which is shown in Fig. 6, include devices to measure the flow pattern of hot gases, and clearance meters to record various clearances between operating parts of the engine. Nearly two hundred temperatures are either recorded or indicated on these various instruments.

After the green run, the engine is moved to a disassembly line and completely dismantled. Components are thoroughly re-inspected. Included in these teardown checks are magnetic particle and fluorescent penetrant inspections, in addition to dimensional checks.

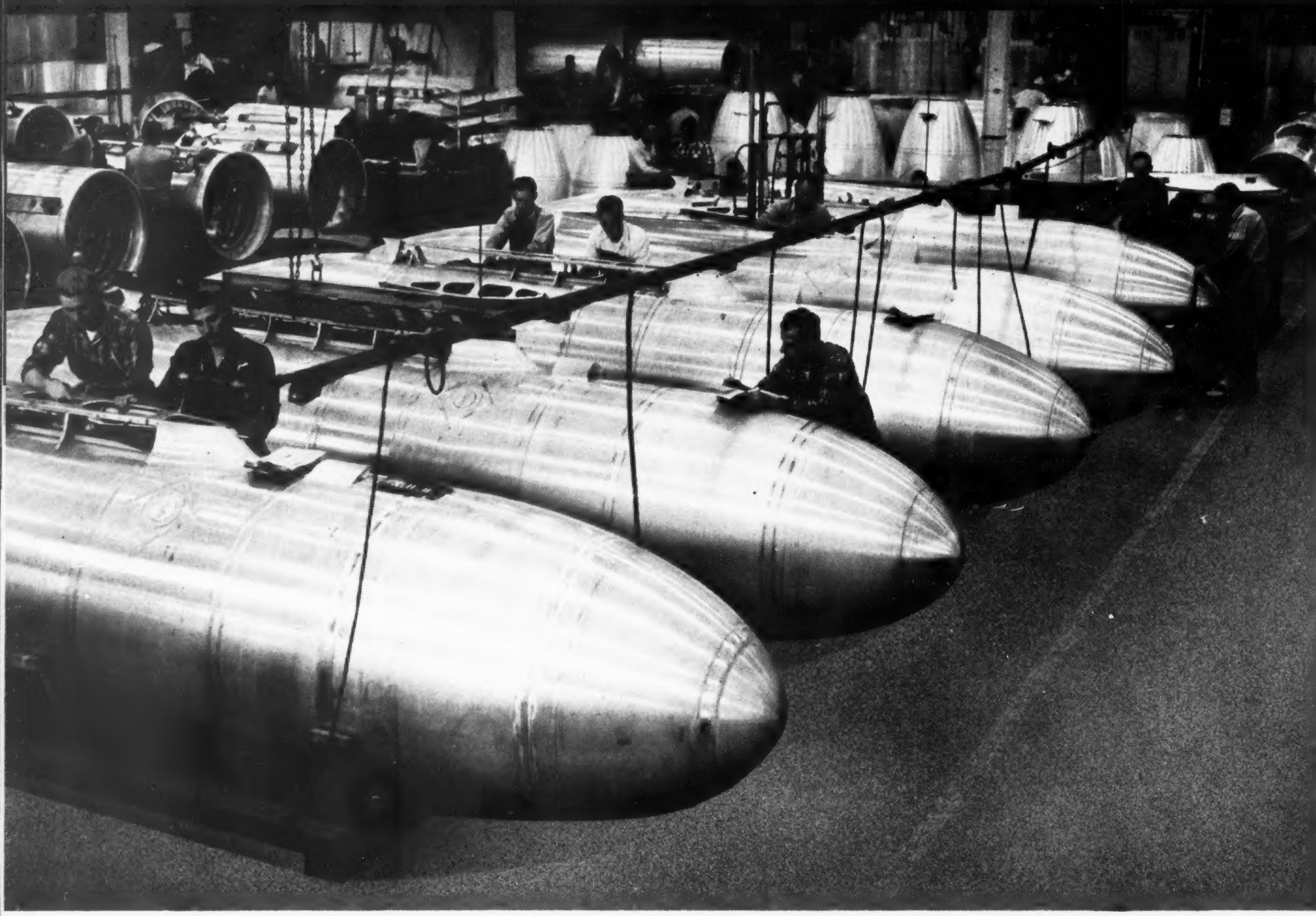
Compressor rotor assemblies are dynamically balanced to within 0.6 ounce-inch both at the completion of the rotor build-up and again after the green run operational test. These operations are performed on balancing machines such as the one seen in Fig. 7. Any unbalance will cause vibration of the cradle in which the compressor rotor assembly is mounted, and the resulting displacement is amplified and measured to show the amount of unbalance.

Final assembly of the engines follows the same general procedure as assembly for the green run. Written assembly procedures are followed and Inspection Procedure Sheets are again used to insure uniform and complete inspections. The engine history record which started with the engine during the green run assembly, follows the engine through final assembly and test to the shipping door, after which it is permanently filed. Leak test, operational performance checks in the test cell, and visual inspections are repeated prior to shipment of the engines.

Good inspection requires accurate equipment, and to have accurate equipment, it must be properly controlled. Proper control necessitates that inspection equipment be checked before it is put on the job and periodically thereafter to maintain its accuracy. Located throughout the Aircraft Gas Turbine Divisions are several standards rooms. In these rooms, new tools and gages are checked to masters, gage-blocks, accurate variable-reading indicators, or special set-ups before being placed on the job. They are coded by means of a system which provides for specifying the date upon which they will have to be rechecked. When the period expires for which their use has been authorized, they are rechecked in the standards room and again coded with a new expiration date.

The efforts and manpower that the General Electric Co. and the United States Air Force are devoting to all phases of inspection in jet engine production are paying dividends. Improvements in such important quality characteristics as performance, reliability, and increased operating time between overhauls are some of the tangible results from this intensive inspection program.

Huge Fuel Tanks for



THE largest external fuel tanks known to be in production are coming from assembly lines at Ryan Aeronautical Co., San Diego, Calif. With a record-breaking, still secret capacity for carrying kerosene or gasoline, these mammoth containers will bring increased range to the Boeing B-47B Stratojet, world's fastest bomber, and the new Fairchild C-119H cargo and troop carrying transport. In the C-119H, all of the fuel is carried in these external tanks which save 800 pounds of weight and reduce the vulnerability to fire. The tanks are permanently affixed on this plane and would not be jettisoned. The torpedo-like structures are cylindrically shaped, with tapered nose and tail domes that are aerodynamically smooth. More than 30,000 electric spot welds are used to join the strong aluminum-alloy sheets which form their lightweight design.

The tanks have amazingly few components. No longitudinal members are used in the design and very few bulkheads are required. From the inception of the design, Ryan engineers have worked closely with the company's production tooling experts to simplify the fabrication of the tank. Electrical resistance welding is employed as the principal joining method. All circumferential joints are closed with two rows of spot welds, and one row of seam-welding insures a gas-tight seam. The single longitudinal seam, running through the individual tank sections, is fusion-welded on automatic Heliarc welding machines, Fig. 1. These machines provide strong, flat, and clean seams which are no thicker than the metal itself. Such welds do not require splice plates, and they can be overrun by seam-welding machines later.

One of the largest projects ever attempted in the aircraft industry with spot-welded aluminum alloy, the tank posed a number of perplexing problems for production. First, the size of the structure exceeded standard welding equipment

the Stratojet Bomber

Boeing B-47 Stratojet Bomber Showing External Fuel Tanks

By
LAWRENCE M. LIMBACH
Works Manager
Ryan Aeronautical Co.
San Diego, Calif.

Immense Fuel Tanks that Can be Dropped from the Airplane Wing when Empty are being Mass-Produced at Ryan's San Diego Plant by Electric Resistance Welding. The Tanks are Comparable in Size to the Fuselage of a Four-Place Navion Plane

dimensions. Second, the alloy did not respond satisfactorily to commercial cleaning compounds in that the surface resistance obtained was not acceptable for certified spot-welding. Third, the requirement that the huge containers had to be absolutely gas-tight by welding alone, made exceptional cleaning and welding supervision a "must."

To handle the welding tasks, Ryan plant engineers ordered and installed some of the largest and most versatile equipment of its type. Four pairs of Federal seam- and spot-welding machines, Figs. 2 and 3, were installed in the production area. Trained two-man teams were placed on each machine: one to operate the machine and the other to control the feed of the work. With a 60-inch throat depth, these big machines actually weld the work 62 inches above the floor. They can fire 120,000 amperes between sheets which are squeezed together with 11,300 pounds pressure between electrodes. They can produce more than 200 spot welds per minute, and as many as nine welds can be made in 1 inch of length. These large welding machines were designed to Ryan specifications.

Special equipment was needed to feed the work to the welding machines, and Ryan has devised a system which has proved very practical. Tank sections are loaded on steel dollies by means of an overhead monorail system, using electric hoists. The dollies are rolled to the welding equipment on steel tracks which are carefully located to feed into each machine. Rotation of the circular sections is accomplished by rollers in the dollies, and a hydraulic cylinder is installed in each dolly to swing the sections from one side to the other, at one end. It is possible to move tapered sections angularly as they are rotated, and thus produce straight welded seams over tapered surfaces.

A high-strength aluminum alloy without cladding is used for the fuel tanks. This alloy is also

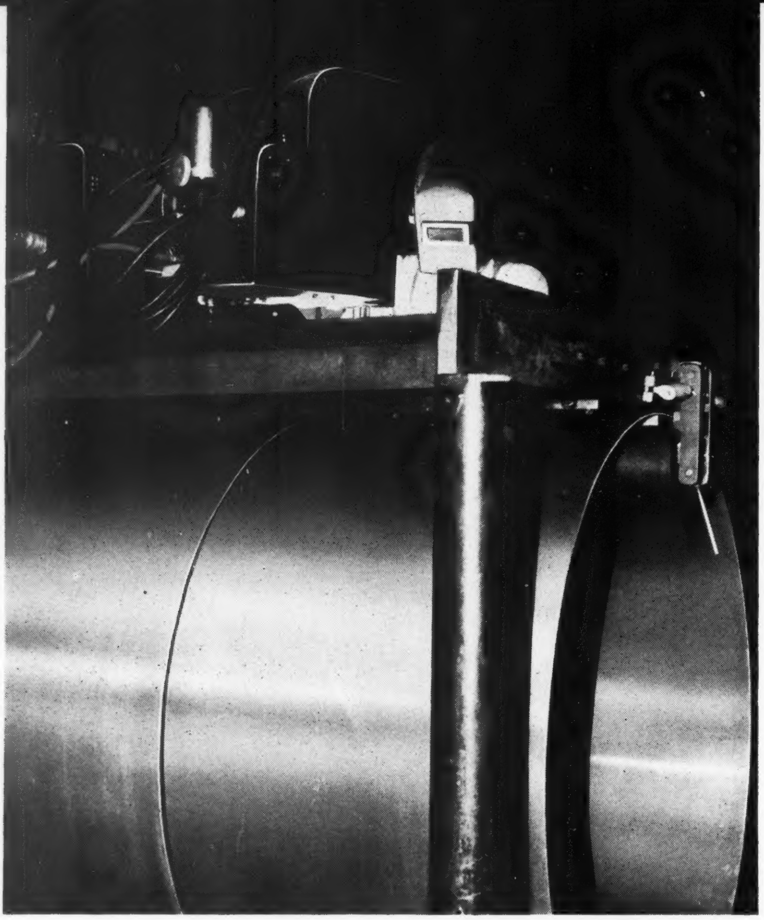


Fig. 1. Longitudinal seams connecting the individual tank sections are fusion-welded on automatic Heliarc welding machines.

desirable because its high ductility makes it adaptable to resistance welding. It is, however, difficult to clean thoroughly, and none of the commercially available compounds would clean it uniformly. The removal of oxides was spotty with commercial compounds, which was detrimental to good spot-welding results.

In the Ryan development laboratory, a new cleaning agent, RACO 34, was developed which removes all oxides with smooth uniformity. The cleaned surfaces have a low surface resistance which is maintained for longer periods. The process is not critical, giving the same good results with immersion periods varying as much as from two to twenty minutes. Daily charts of surface resistance show that a consistent figure

Fig. 2. Huge seam-welding machine which is capable of delivering 120,000 amperes per second and a pressure of 11,300 pounds

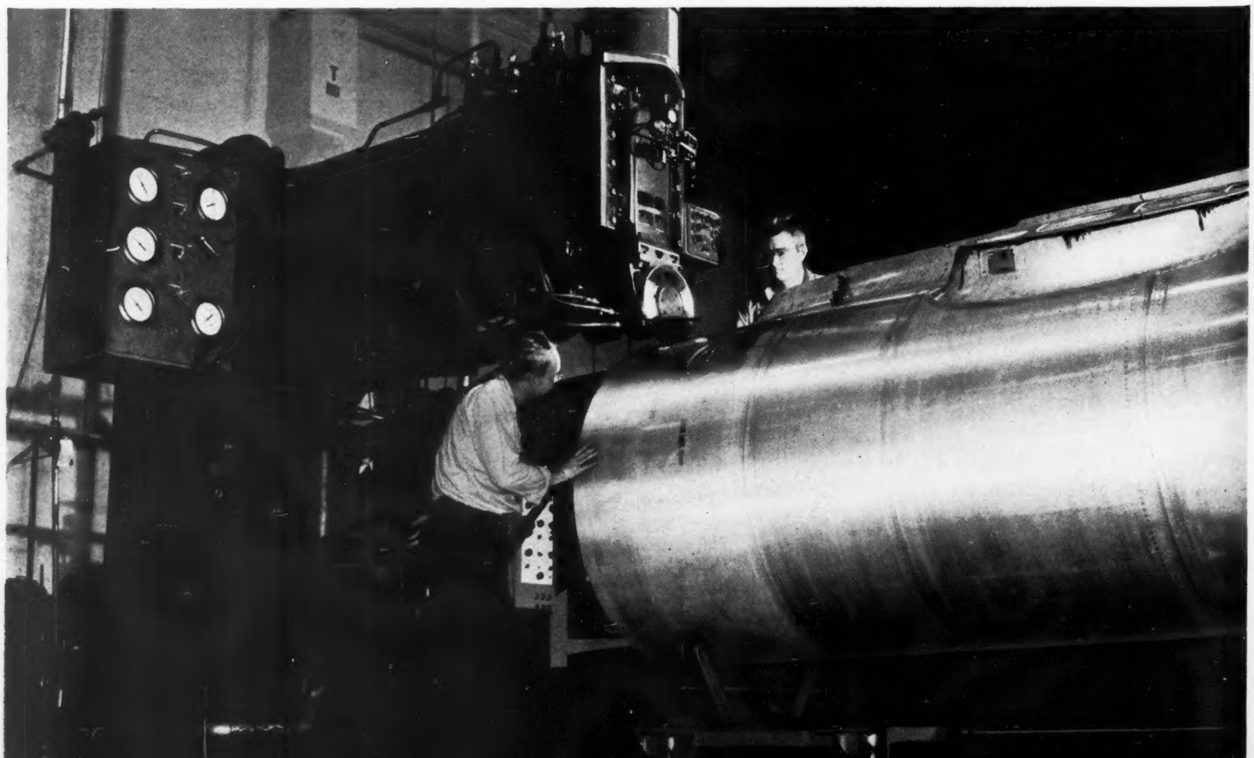
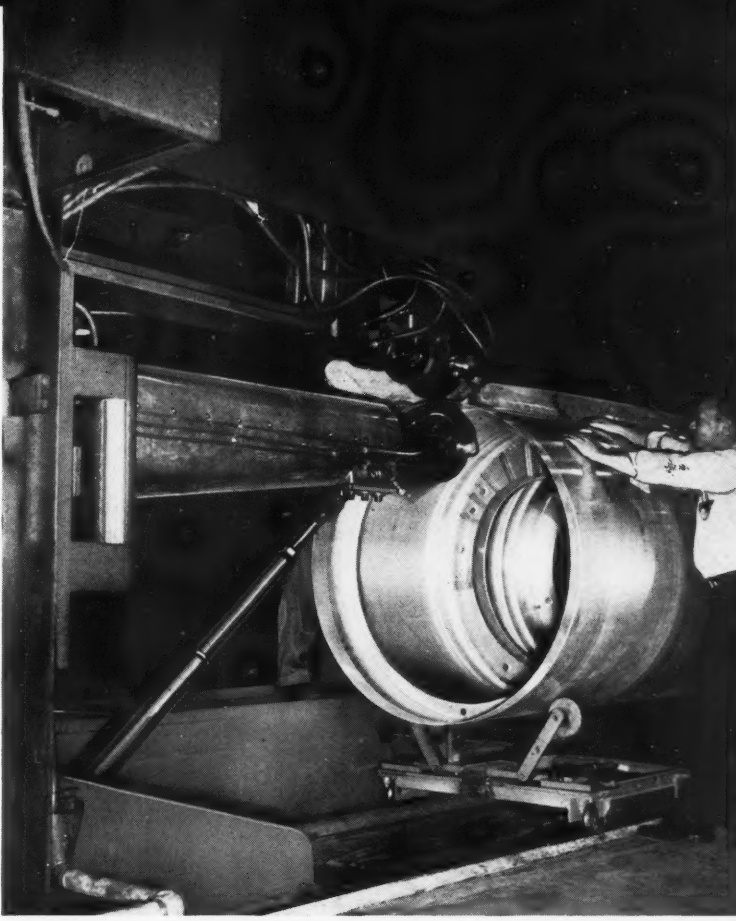


Fig. 3. Close-up view of the Federal seam-welding machine, Fig. 2, which has a throat 60 inches deep for welding large fuel tanks



running between 10 and 15 microhms is attained. This is well below the required 50-microhm limit specified.

Because of the nature of resistance welding, a major concern to Ryan production planners was the requirement that the big tank be made leak-tight by welding alone. The strength of welds is critically related to the condition of the surfaces welded and the behavior of the welding equipment. One grease spot, or foreign particle, can cause temperatures to rise rapidly and produce an explosive melting of metal with a resultant hole in the sheet.

Consequently, exacting care is taken to prepare the sheets and govern the performance of the machines. All aluminum alloy is welded

Fig. 4. Each welded fuel-tank section is pressure-tested individually before assembly to insure that they are gas-tight.

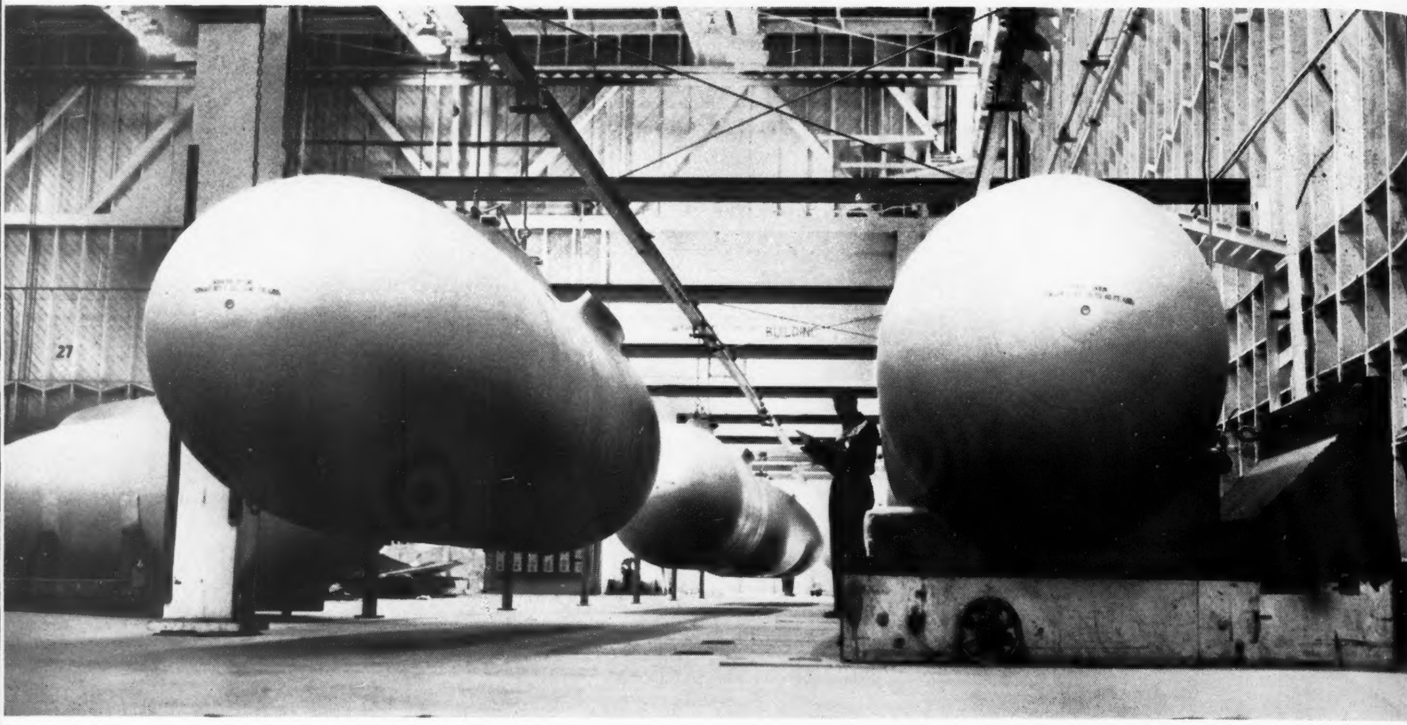


Fig. 5. Large fuel tanks are suspended from overhead monorail conveyors as they come from the final assembly line and paint spray booth.

within twenty-four hours after thorough cleaning in nearby tanks. Test samples are taken from the machines each hour and subjected to a tensile test of 1200 pounds. Also, regular X-ray examinations are made of sample spot-welded pieces to check the microstructure of the material in the weld. In specially made Ryan jigs, Fig. 4, each tank section is individually pressure-tested with 3 1/2 pounds per square inch pressure to find any existing leaks.

Rigid inspection is necessary before these tanks are prepared for shipment. The results of the careful planning of this project, from the engineering conception through all phases of production, have been most gratifying. Large numbers of the tanks have been produced and none has been rejected because of defective design or workmanship.

Completed tanks are shown in Fig. 5 suspended from an overhead conveyor system. They have been sprayed with a protective film that prevents the metal from being scratched during shipment. After shipment to the Boeing Airplane Co., Wichita, Kan., the tanks are installed on wings of six-jet, 600-mile-per-hour, B-47B Stratojet bombers to increase their combat range. The fuel tanks alone are as large as the fuselage of a Ryan Navion four-place executive plane, and can carry a service station full of gasoline. Exact dimensions and capacity of the tanks are secret. The tanks are designed so they can be released from the airplane when empty.

New Reliance Plant Features Flexibility

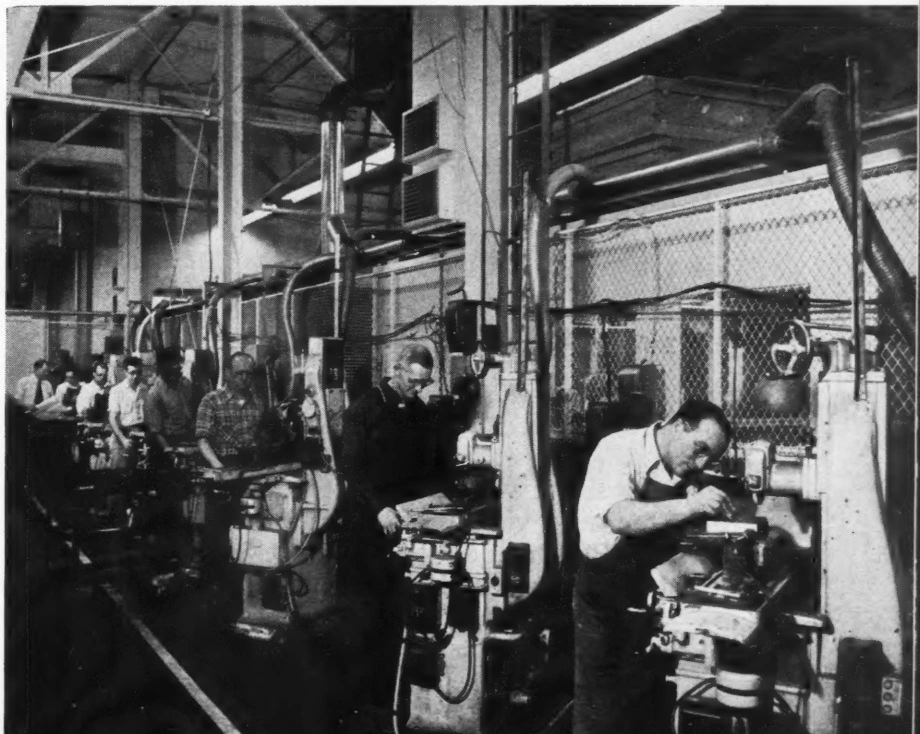
TO broaden the scope of its facilities for designing, developing, and manufacturing motors and associated electric drive control equipment, the Reliance Electric & Engineering Co. has completed a $1,800,000 plant in Euclid, Ohio. The second plant to be built by the company since the end of World War II, it reflects a great deal of planning for future growth. Designed for multi-functional usage, the new plant's production facilities are readily convertible to meet the changing requirements. The building, having a floor area of 133,000 square feet, is located on a 65-acre plot.

The plant enables Reliance to centralize engineering, research, and development laboratories. This plant also manufactures electronic equipment and motor drive controls (output of which is being stepped up 100 per cent); handles renewal parts, motor repair, and related customer service activities; and designs, develops, and manufactures specialized tools, dies, jigs, fixtures, etc., required by the company's production departments in Cleveland and Ashtabula. A view of the tool-room in the Euclid plant is shown in the accompanying illustration.

An electronic "Analog Computer" has been installed to speed up mathematical calculations for electric motor design and performance. Because involved mathematical computations can be performed electronically in a fraction of the time required by ordinary means, the saving in man-hours is tremendous, and especially so when more than one solution to a problem needs to be explored. Engineering problems requiring as many as sixty to seventy solutions have been solved in two to three hours. Three months or more would be required by a highly trained mathematician to solve these equations.

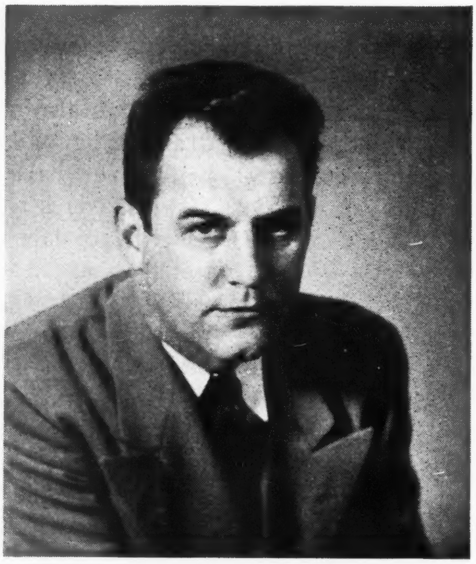
A new drafting process, "Ree-Copy," developed by Reliance to reduce by one-third the time consumed in laying out engineering drawings makes use of equipment "miniatures" or templates containing small permanent magnets. The drawing board is metal-faced, to which is affixed a photosensitive sheet. On this sheet is placed (if desired) a thin, transparent "master image" sheet that bears standard notations or configurations—border, titles, indicated boundries, etc. Finally, on top of this sheet, are placed the templates conforming to the required components to be indicated on the drawing.

These components thus need not be drawn as they are exactly duplicated each time; the draftsman simply moves them around freely to suit any arrangement he desires. The permanent magnets cause the templates to remain fixed in whatever position they are placed on the board and, by magnetic attraction, to adhere closely to the photosensitive surface to insure good contact printing. The complete assembly is then exposed and developed. The photosensitive material used may be ordinary blueprint or whiteprint paper, which, because it has a relatively slow photosensitive coating, obviates the need for a mask under normal drafting-room lighting conditions. The resultant print is a rough lay-out on which the draftsman draws his hook-up lines. Thus, he can determine quickly whether or not he designed a suitable assembly, and if a change is necessary, he can easily make another lay-out.



Tool room in new Reliance plant manufactures specialized tools, dies, jigs, fixtures, etc., required by production departments in the company's other plants

Alan Brown Wins The Industrial Press Award



Alan Brown, advertising manager of the Bryant Chucking Grinder Co., winner of The Industrial Press Award

THE Industrial Press Award of $1000, established by the publishers of MACHINERY to be given to the industrial advertising man who, during the last year, made the best documented presentation to his management to prove the need for a specific advertising program, offering at the same time a program to fill that need, was won by Alan Brown, advertising manager of the Bryant Chucking Grinder Co., Springfield, Vt. The Award was presented to Mr. Brown on July 2 at the thirtieth annual conference of the National Industrial Advertisers Association, which was held at the Palmer House, Chicago, Ill. In addition to the first-prize award, G. T. Van Alstyne, advertising manager of the Air Reduction Co., Inc., and George H. West, advertising manager of the Consolidated Engineering Co. were given honorable mention.

A panel of judges, set up by the Awards Administrative Committee of the N.I.A.A., studied all entries received and made the final selection. The panel consisted of Edward R. Gay, executive vice-president of the St. Regis Paper Co., chairman; Lowell F. Halligan, vice-president in charge of sales of the Hamilton Watch Co.; W. R. MacIntyre, president of Joseph Bancroft & Sons Co.; D. J. Richards, vice-president in charge of sales of E. F. Houghton & Co.; and P. B. Stull, vice-president of the Hercules Powder Co.

Alan Brown attended Union College, Schenectady, N. Y., and later transferred to Black Mountain College in North Carolina, where he studied industrial design. For the last sixteen years he has been engaged in industrial design, and during this time has had intimate contact with manufacturing processes, machinery, product design, and the graphic arts. While with the W. H. Nichols Co., Waltham, Mass., as a design engineer, he became interested in company advertising problems. In 1946 he joined the Bryant Chucking Grinder Co. as advertising manager, and at present has the double-barreled title of advertising manager and industrial designer.

In presenting the Award to the winner, Robert B. Luchars, president of The Industrial Press, pointed out that the purpose is to help advertising men solve what is sometimes one of their toughest problems. When indifference or an unsympathetic attitude toward industrial advertising is combined with the weight of authority which top management executives carry, a serious obstacle is presented to advertising managers and agency executives. Unless the advertising manager attacks the problem with a fact-studded presentation to the executives, backed up by field data and records, he is not likely to get very far.

On some occasions, executives who have had

little or no field experience assume that selling a product is a far simpler operation than it actually is, and that the sales staff can do the whole job without any help. So long as top management believes this, there is not much chance of selling even the best of advertising plans. By proving that such a need *does* exist, the rest is relatively easy. The important thing is to set up a "needs" pattern based on front-line selling facts. Even when top management is thoroughly advertising-minded, that is sound practice.

It is the aim of The Industrial Press Award not only to recognize and reward the advertising executive who has done a conspicuous job of selling his advertising program to top management, but through the resulting publicity about the ways and means that this was accomplished, to encourage and stimulate others to do likewise. Conceivably some of this publicity may seep into upper management levels with good results.

The judges were thanked for the excellent job done and for the time they so generously gave in passing upon the entries. Thanks were also expressed to Robert C. Myers, general chairman of the Awards Administrative Committee, to Blaine G. Wiley, executive secretary of N.I.A.A., and to J. W. Dolson who organized the panel of judges and carried the job through successfully.

Foreign Group to Study American Production Methods

Two hundred leading European engineers will study American production methods in conjunction with their attendance at the Centennial of Engineering, scheduled to open in Chicago, Ill., on September 3. Present plans call for the foreign visitors to spend at last five weeks in this country.

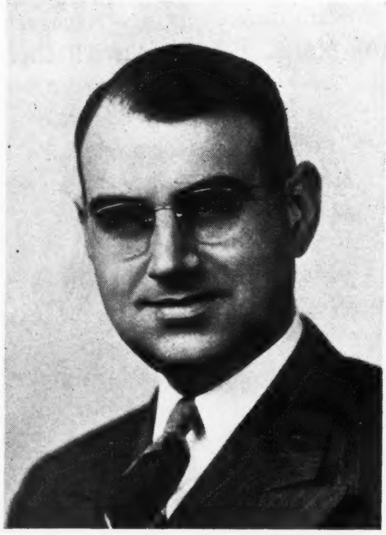
Following participation in the Centennial convocation, the engineers will tour key production centers in this country. The purpose of the tour will be to give these people an opportunity to observe American methods of design, construction, and operation of engineering works, as well as American methods of mass production and distribution.

* * *

Gasoline, the internal combustion engine, and the pneumatic tire are the three factors that accounted for development of successful automobiles in the 1880's and 1890's in the United States and Europe, according to General Motors Research Laboratories engineers. The industry is still dependent on those three major factors.

Panel of judges established by the National Industrial Advertisers Association to determine the winner of The Industrial Press Award. (Left to right) D. J. Richards, P. B. Stull, Edward R. Gay, Lowell F. Halligan, and W. R. MacIntyre

Gear Manufacturers Hold


(Left to Right) S. L. Crawshaw, newly elected president of the American Gear Manufacturers Association; George H. Sanborn, vice-president; and R. B. Holmes, treasurer

MEMBERS of the American Gear Manufacturers Association convened at the Homestead, Hot Springs, Va., on June 2, 3, and 4 for their thirty-sixth annual meeting. S. L. Crawshaw, assistant to the president of the Western Gear Works, Lynwood, Calif., was elected president of the association for the current year. George H. Sanborn, Detroit district manager and chief field engineer of the Fellows Gear Shaper Co., Springfield, Vt., was elected vice-president; and R. B. Holmes, general manager of the Philadelphia plant of the Link-Belt Co., was elected treasurer.

The following members were elected to the executive committee of A.G.M.A.: R. C. Wilson, manager of sales of the Buffalo, N. Y., Division of the Farrel-Birmingham Co., Inc.; Charles Everett Stine, president of the Ferguson Gear Co., Gastonia, N. C.; L. J. Collins, gear engineer, Medium Steam Turbines, Generators, and Gear Department of the General Electric Co., Lynn, Mass.; and Ervin F. Borisch, executive vice-president of the Milwaukee Gear Co., Milwaukee, Wis.

An outstanding paper presented at the meeting was "Ductile Iron as a Gear Material" by Bayo Hopper, chief engineer, Lufkin Foundry & Machine Co., Lufkin, Tex. Mr. Hopper stated that the introduction of nodular iron, commonly referred to as spheroidal or ductile iron (patented by the International Nickel Co., Inc.), has perhaps been the most remarkable development in the gray iron foundry industry during the twentieth century. This development was first announced in 1948, and the first commercial production was poured in 1949.

Ductile iron is produced by the accurate addition of magnesium to controlled gray iron in the molten state. A relatively simple procedure is followed to convert this gray iron into a spheroidal graphite or duticle iron having high tensile strength, capable of 2 to 10 per cent elongation as cast, and possessing a straight-line stress-to-strain ratio to a high proportional limit, with a tensile modulus of elasticity of 25,000,000 pounds per square inch.

The most common method of producing ductile iron is in the cupola, but any type of melting medium may be used with good results. After tapping out into the receiving ladle in the usual manner, the magnesium is placed in the bottom of the empty pouring ladle in the form of a magnesium alloy The iron is poured from the receiving ladle into the pouring ladle on top of the magnesium alloy. It has been found that by this method of making the addition the greatest magnesium recovery is obtained.

The molding practice is essentially the same for ductile iron as for cast iron, except that larger gates and risers, which are more in line with cast steel practice, are ordinarily required. This is because of the relatively high liquid shrinkage. The casting shrinkage for ductile iron is approximately the same as for cast iron. Patterns made for cast or malleable iron are, therefore, satisfactory for ductile iron. Because of the machining stock allowed on patterns for

Thirty-Sixth Annual Meeting

cast steel gears, these patterns, with only slight modifications, will generally be satisfactory for ductile iron castings.

In typical, ordinary cast iron, the free carbon is in the form of thin flakes. Since the graphite has little strength to hold the particles of iron together, the cast iron has relatively low tensile capacity. In typical ductile iron, however, the free carbon is in the form of spheroids.

Although ductile iron can be produced in any high-class gray iron foundry, satisfactory results will not be obtained consistently without very precise control over metallurgy and cupola operation. At Lufkin, the practice is to hold the chemical composition within the following range, in percentages: Carbon, 3.5 to 3.8; silicon, 2.5 to 3.0; manganese, 0.4 maximum; phosphorus, 0.1 maximum; sulphur, 0.04 maximum; and magnesium, 0.05 to 0.08. Within the range of 2.5 to 4.0 per cent a variation in carbon has very little effect on the physical properties. A lower carbon will result in excess shrinkage.

A low silicon content will result in a white iron which is not nodular. High silicon causes embrittlement. Manganese is a hardening agent, and if higher than 0.4 per cent will have practically no elongation as cast. Manganese should be as low as possible—it would be highly desirable but quite impossible to eliminate it altogether. Phosphorus should be as low as possible. A high phosphorus content results in lowered strength and ductility. Sulphur present in the bath will combine with magnesium until the sulphur content is reduced to about 0.015 per cent.

The retained magnesium content must be maintained as high as 0.05 per cent in order for the free carbon to form in the shape of spheroids. When the magnesium content is as low as 0.04 per cent, the graphite will be only partially in the shape of spheroids, with the remainder in the form of flakes. The tensile strength will be lowered proportionately with the reduction in the amount of spheroidal graphite.

There is a fairly definite relationship existing between strength and hardness of ductile iron. In the "as-cast" condition, high strength and high hardness can be obtained but ductility will generally be low. Annealing will reduce the strength and hardness, but elongation in the neighborhood of 20 per cent or better can be obtained. Ductile iron can be quenched and drawn for strength improvement and for control of hardness. Ductile iron in this condition is generally employed for gear applications, although fully annealed gears are quite satisfactory so long as the hardness obtained is adequate for the application.

Considerable experimental work and testing have been done by Lufkin in connection with the use of ductile iron as a gear material for the standard type commercial gear reducer and for oil-field pumping unit gear reducers. Many gears were tested at various hardnesses and were found to be in excellent condition after carrying their rated loads for extended periods. Considerable evidence was obtained to substantiate the belief that properly controlled ductile iron gears, accurately manufactured and assembled, might carry the full rating currently being used by A.G.M.A. for steel gears.

Standards Considered by Committees

Many well attended committee meetings were held by the four main divisions of the American Gear Manufacturers Association to draft, revise, adopt, or approve tentative or full standards. Committees under the Speed Reducer and Gearmotor Division that held meetings were: High-Speed Gear Units; Helical and Herringbone Speed Reducers; Gearmotors; and Worm Gearing. Committees on Worm, Fine Pitch, Aircraft, Bevel, Automotive, Mill, Spur, Helical, and Herringbone Gearing met under the General Gearing Division. The following committees of the Development Division also met: Gear Rating Coordinating; Tolerance Standards Coordinating; Gear Cutting Tools; Technical Editing; Materials; Lubrication; Nomenclature; Tooth Form; and Inspection.

Under the Industry Problems Division, the Statistics and Accounting Procedures Committee studied the contents and application to gear manufacturers of the *M.A.P.I. Accounting Manual* published by the Machinery and Allied Products Institute. A discussion of the manual was led by one of its authors, Dundas Peacock, controller of the Elliott Co. The manual explains accounting in terms understandable to general management officers not trained in accounting.

At the thirty-sixth annual dinner, Louis D. Martin, gear engineer with the Eastman Kodak Co., Rochester, N. Y., delivered an inspired address in presenting Douglas T. Hamilton with a bound volume of commendatory letters from his friends. Mr. Hamilton is retiring from his position as advertising manager of the Fellows Gear Shaper Co., Springfield, Vt.

Materials OF INDUSTRY

The Properties and New Applications of Materials Used in the Mechanical Industries

Water Hardenable Steel for Cold-Heading Dies

An improved die steel for cold-heading dies has recently been introduced by the Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pa. "Alhead," as it is called, can be water-hardened in the same manner as straight carbon or carbon vanadium steels and will have a case of equivalent depth and hardness.

A typical analysis of this steel is as follows: Carbon, 1.00 per cent; tungsten, 1.50 per cent; cobalt, 1.50 per cent; and iron, 96 per cent. The tungsten content imparts added abrasion resistance to the hardened case. The cobalt performs two functions: (1) Its negative effect on hardenability offsets the positive hardenability of the tungsten, resulting in a case penetration equal to the straight carbon steels; and (2) it imparts strength to the matrix of the steel. Fully annealed Alhead has a hardness of 192-217 Brinell, and machines without difficulty.

Bars Cast from Aluminum Alloys in Various Shapes

Bar stock for screw machine and forging operations is now cast from aluminum and all other non-ferrous metals under Goss patents by the Apex Metal Products Corporation, 6700 Grant St., Cleveland, Ohio. This process involves no intermediate forming, and billets for extrusion and slabs for rolling can also be cast.

In this process the molten metal is cast directly into the form in which it is to be used. While rod and bar are the simplest forms to produce, the process is not limited to simple shapes —hexagons, ovals, wedges, squares, and even thin rectangles can be cast directly.

The wide range of alloys which may be cast is one of the important advantages of the process. Inasmuch as attention to the extruding, rolling, or other forming properties of the alloy is unnecessary, selection can be made for strength, machinability, and corrosion resistance.

For example, bars can be produced of Ternalloy, an aluminum alloy that develops high strengths without the necessity of expensive heat-treatment. Ternalloy also machines more like free-turning brass than aluminum and it has good corrosion resistance. Blanks for forging can be cut from bars produced by this process, thus making the properties of Ternalloy available in aluminum forgings.

Wax Lubricant in Stick Form for Metal-Working Operations

A blend of solid waxes put up in stick form for use in certain types of metal-working operations has been placed on the market by S. C. Johnson & Son, Inc., Racine, Wis. This wax, designated No. 140 "Stik-Wax," is said to provide a durable, clean lubricant for metal-sanding, metal-sawing, pipe cutting and threading, drilling, tapping, grinding, and flush-riveting operations. It can be applied manually, as required, by the operator or placed in a position so that it is automatically applied as the machine operates.

Removable Type Rust Preventive that Absorbs and Evaporates Moisture

Stop-Rust No. 0 Special is a new type of rust preventive which has been developed by the Industrial Research Institute of the University of Chattanooga in collaboration with the Stop-Rust Co., Chattanooga, Tenn. It is not a petroleum-base product. A coating of this preventive absorbs entrapped moisture on the surface of the metal, floats it out to the coating surface, and evaporates it. This same property of absorbing and giving off moisture prevents erosion from the condensation of atmospheric moisture. Applied at room temperature by brushing, dipping, spraying, or wiping on, it is readily removed by commercial solvents such as Stoddard solvent or kerosene.

Die-Casting Book Revised

DIE-CASTING—Second Edition. By Charles O. Herb. 310 pages, 6 by 9 inches; 196 illustrations and tables. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York 13, N. Y. Price, $4.50.

Die-casting from its early phases up to today's advanced practice is thoroughly covered in this second edition. The chapters relating to die-casting machines, die-casting alloys, and steels for dies and die components have been extensively revised. New examples of unusual die-castings have been added—including a detailed description of an induction motor rotor die-cast as a single unit around stacked laminations.

The latest models in automatic and manually operated die-casting machines are illustrated, such as fully hydraulic machines of the vertical cold-chamber and horizontal cold-chamber types, air-operated vertical machines, etc. An interesting adaptation of a vertical hydraulic press to die-casting work is also described.

Six new tables of die-casting alloy compositions and properties have been added to the chapter on alloys, and these are supplemented by the text discussion of their applications.

The chapter relating to steels for die-casting dies will be of particular interest to die designers since the tabular arrangement of the data presented is an aid in the selection of the proper type of die steel for each component of the die-casting die.

As in the previous edition, a distinctive feature is the large number of illustrations and detailed descriptions of dies for parts ranging from simple shapes to complex forms. The die designs which are illustrated are the work of die design specialists, and have been successfully used in industry. To further aid the designer, there is a section illustrating and describing the die design standards used by a leading maker of die-castings and die-casting equipment.

Dies have been classified in groups according to their most distinguishing characteristic in order to facilitate locating a general design or type of die adapted to a given class of work.

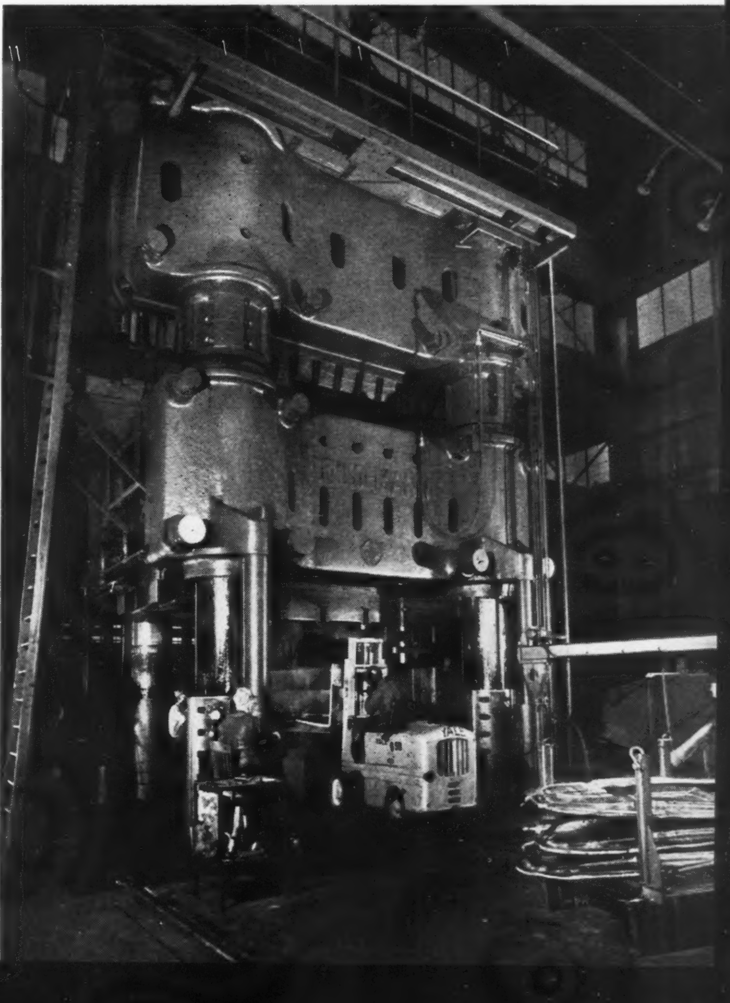
The sixteen chapters in this book deal with the following subjects: The Die-Casting Process and Its Applications; Die-Casting Machines and Their Development; Alloys for Die-Casting; Die-Casting Dies and Their Operation; Multiple-Cavity Dies for Duplicate Castings; Dies with Auxiliary Slides for Exterior Cores; Sliding Cores in Movable and Stationary Dies; Adjustable Dies for Parts of Different Dimensions; Standards for Designing Die-Casting Dies; Steels for Die-Casting Dies; Die-Casting with Semi-Automatic Machines; Die-Casting Thin Sections; Die-Casting Brass; Die-Casting by the Vacuum Process; Unit System of Die-Casting; and Die-Casting Cast Iron.

* * *

Huge Press for Large Aluminum and Magnesium Forgings

The Aluminum Company of America had to erect a building equivalent to a five-story structure in order to house a giant forging press in the Alcoa Cleveland Works. This press was built early in World War II by the Schloemann Co. of Duesseldorf, Germany, for use in the wartime light-alloy industry. The press, which has a capacity of 15,000 tons, has been leased from the United States Air Force for the production of large aluminum and magnesium aircraft forgings. A special overhead crane was installed to lift parts weighing up to 120 tons in reassembling the press.

With auxiliary equipment, the machine is valued at $6,200,000. It occupies a space 22 by 18 feet, and extends 18 feet below and 36 feet above the floor. The foundation required over 1000 cubic yards of concrete.



Giant forging press of 15,000-ton rating installed in the Alcoa Cleveland Works for the production of large aluminum and magnesium aircraft forgings

Hydraulic Press Mfg. Co. Celebrates Seventy-Fifth Anniversary

THIS year marks the seventy-fifth anniversary of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, well-known builder of hydraulic presses and power equipment, plastics molding machines, and die-casting machines. The company literally started with an apple back in 1877, when a hydraulic press was designed to facilitate the making of cider.

Before long, hydraulic presses made by this company began to give a good account of themselves in several industries—tankage presses in meat packing plants, curb presses in grease rendering plants, laminating presses in veneer factories. By the early twenties the application of hydraulic presses had expanded into a wide variety of fields—in railroad shops, as wheel and bushing presses; in rayon mills, as steeping presses; in the production of block salt; and in the manufacture of abrasive wheels. The ability of the hydraulic press to provide high pressure and to sustain that pressure over long periods was a new factor of great importance.

Although hydraulic presses had already come a long way and improvements over the original cider press were many, the presses were still slow and ponderous. They just could not fill the bill in industries where production speed was essential. One obvious means of obtaining more speed was to increase the power available, and generators were built larger and larger. However, the old style reciprocating pumps were so bulky and took up so much valuable floor space that they were very unpopular.

Untiring research and study led to the development by 1926 of a high-speed hydraulic press equipped with its own self-contained radial pump operating system. It was in this manner that H-P-M started building its own pumps, valves, boosters, cylinders, and controls. Today, one entire plant is devoted exclusively to the manufacture of hydraulic components.

The revolutionary new press opened the doors for all types of pressure processing applications. Capacities of self-contained presses of this type seemed practically unlimited. The new, compact radial pumps, directly connected to each press, were but one-tenth the size of reciprocating pumps of comparable capacities. This period also marked the beginning of the use of oil as the principal hydraulic pressure medium. In earlier hydraulic presses, water was almost invariably used. Oil soon proved its superiority, because of its self-lubricating qualities.

H-P-M presses today step up production on a wide variety of metal work—deep-drawing, extruding, embossing, forging, die-casting, powder metallurgy, sizing, die-straightening, pipe bending, and rubber-pad forming. In the field of plastics, H-P-M pioneered the first commercial injection molding machine in the United States in the early thirties. The company at present offers a complete line of injection and compression molding machines and transfer and laminating presses.

* * *

General Electric Opens New Switchgear Laboratory

A few miles from the site of Benjamin Franklin's famous kite experiment of exactly two hundred years ago, in Philadelphia, the General Electric Co. recently opened its new Switchgear Development Laboratory. Completed at a cost of $10,000,000, the laboratory consists of a test building, a high-voltage yard, and a control building. In the test building are the generators, exciters, reactors, bus runs, circuit breakers, and auxiliary service apparatus. Five test cells are located in one side of the building in full view of the control building. The generators, designed especially for testing, provide the necessary power. When operated in parallel they can produce short circuits of 5,250,000 kilovolt-amperes—the most ever produced in a research facility.

In the high-voltage yard are step-up transformers, disconnecting and tap switches, lightning arresters, capacitors, and high-voltage connections. Tests up to 440 kilovolts are made in this area. Switching operations for the test circuits are initiated from a master benchboard in the control building. The operator has a clear view of all test areas from this position. Here also are high-speed cathode ray oscillographs for recording the highly transient phenomena of the tests.

This modern testing laboratory is to be used primarily for the development of high- and low-voltage circuit interrupting devices—such as circuit breakers, fuses, distribution cut-outs, and lightning arresters—and of power switching equipment where recovery voltages, capacitance and thermal effects, and electromagnetic forces are important factors in the operation and life of the apparatus.

TOOL ENGINEERING *Ideas*

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Conveyor Rotates Cylinders while Transporting Them

By HAIM MURRO, Cambridge, Mass.

The processing industry often requires a materials-handling system that simultaneously conveys and rotates cylindrical packages. A typical application would be to convey cans through an oven, and in order to avoid precipitation, to rotate them at the same time.

The principle of such a system is shown schematically in Fig. 1. Two conveying belts, *A* and *B*, are friction driven by pulleys which run in the same direction, either clockwise or counter-clockwise. Thus, the two facing sections of the belts move in opposite directions. If the belts travel at the same speed, a cylinder *C* in contact with both facing sections will be rotated by the friction of the belts, but will remain in the same place and will not be conveyed. On the other hand, the cylinder will be conveyed as well as rotated when the belts run at different speeds.

Theoretically, any combination of conveying speed and rotative speed can be given to a cylinder by selecting the correct belt speeds. Actually, the selection is governed by such considerations as the range of available pulley speeds and the desired conveying and rotative speeds of the cylinder. Expressed mathematically the conveying speed of the cylinder is

$$V_c = \frac{V_a - V_b}{2} \qquad (1)$$

and the rotative speed of the cylinder is

$$N_c = \frac{V_a + V_b}{2\pi D} \qquad (2)$$

in which

V_a = speed of belt *A*, in inches per minute;
V_b = speed of belt *B*, in inches per minute;
V_c = conveying speed of cylinder, in inches per minute;
N_c = rotative speed of cylinder, in revolutions per minute;
D = diameter of cylinder, in inches.

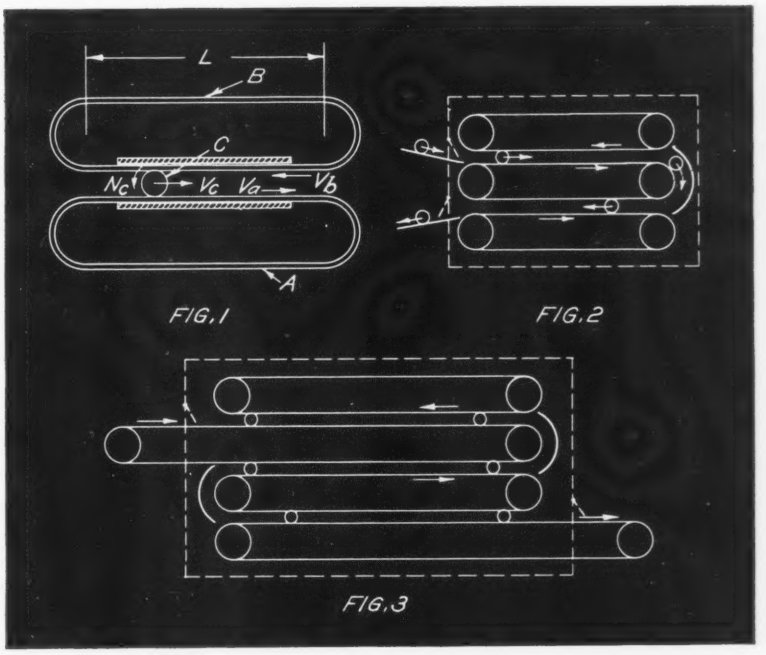


Fig. 1. A cylinder is conveyed and rotated simultaneously between two belts running in opposite directions and at different speeds. Fig. 2. Three belts permit a shorter oven to be designed, charging and discharging both being performed at the front. Fig. 3. With a fourth belt, the cans are discharged at the rear of the oven.

These equations illustrate that raising the speed V_a of belt A raises both the conveying and rotative speeds of the cylinder; whereas raising the speed V_b of belt B raises the rotative speed but lowers the conveying speed of the cylinder.

By transposing Equations (1) and (2),

$$V_a - V_b = 2\ V_c \qquad (3)$$

$$V_a + V_b = 6.28\ N_c D \qquad (4)$$

belt speeds can be determined.

Problem: An oven 10 feet long is to heat a 10-inch cylinder for one hour, keeping the cylinder rotating at twelve revolutions per minute. At what speed should each belt run?

Solution: By solving for V_a and V_b, Equations (3) and (4), $V_a = 378.8$ inches per minute, and $V_b = 374.8$ inches per minute.

Four general conclusions can be drawn about the interrelationship of the belt speeds and the conveying and rotative speeds of the cylinder, it being assumed from Fig. 1 that the cylinder is to rotate counter-clockwise and is to be conveyed to the right.

1. To obtain a slow conveying speed and a fast rotative speed of the cylinder, use fast belt speeds with belt A running slightly faster than belt B.
2. To obtain a slow conveying speed and a slow rotative speed of the cylinder, use slow belt speeds with belt A running slightly faster than belt B.
3. To obtain a fast conveying speed and a fast rotative speed of the cylinder, use fast belt speeds with belt A running considerably faster than belt B.
4. To obtain a fast conveying speed and a slow rotative speed of the cylinder, use slow belt speeds with belt A running considerably faster than belt B.

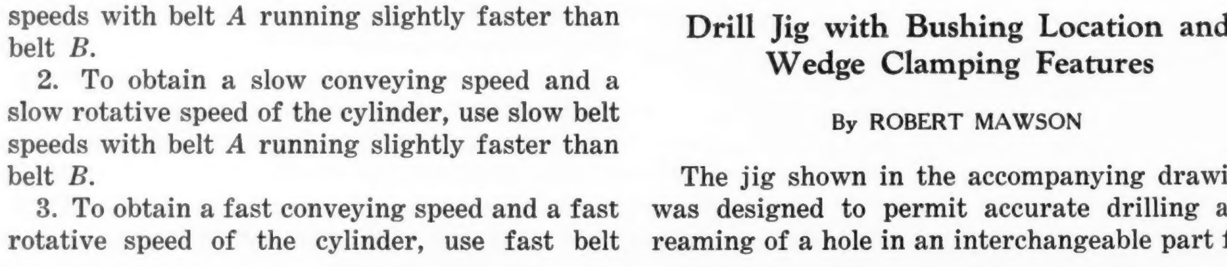
A system of an effective length L inches will keep each cylinder on it for $\dfrac{L}{V_c}$ minutes, after which time it will also start to discharge the cylinders at the rate of one each $\dfrac{D}{V_c}$ minutes. This is also the rate at which the conveyor can be loaded. The capacity of such a conveyor will, of course, be multiplied when a wide belt is used, with partitions to separate the lanes.

If a long narrow oven is impractical, belts could be added to convey the cans in two directions, with the discharging at the front, as in Fig. 2, or at the rear, as in Fig. 3.

Drill Jig with Bushing Location and Wedge Clamping Features

By ROBERT MAWSON

The jig shown in the accompanying drawing was designed to permit accurate drilling and reaming of a hole in an interchangeable part for



Jig employed for drilling and reaming a hole through the square-shanked end of a grinding machine detail (X). The work-piece is accurately located and aligned by wedge (J) and bushing (H), and clamped by nut (F) which is screwed on threaded end of work-piece.

grinding machines made by the Taft-Peirce Mfg. Co., Woonsocket, R. I. The part *X*, a saddle clamping rod post, has a square shank on its left-hand end, and the required hole must be square with this shank. This is accomplished by locating the work-piece in a bushing, and clamping by means of a screw-actuated wedge.

Secured and doweled to body *A* of the jig is a bushing plate *B*, into which liner bushing *C* is pressed. A slip drill bushing *D* fits into the liner bushing, and is replaced by a slip reamer bushing after drilling the required hole. The slip bushings are locked in place by screw *E*.

A special nut *F*, placed in a hole in the right-hand end of the jig body, is internally threaded to fit the threaded end of the work-piece. This nut is held in place in the jig (but permitted to rotate) by pin *G*, which fits into grooves machined in the nut and jig body. Pressed into the same hole in the jig body, but from the opposite cut-away end, is a work-locating bushing *H*. The bore of this bushing is a sliding fit for the cylindrical shank on the work-piece.

Wedge *J* is mounted in a beveled slot machined in the jig body. Stud *K*, which operates the wedge by being screwed into the jig body, passes through a slot in the wedge. The stud is screwed into or out of the body by means of knurled knob *L*, which is pinned to the outer end of the stud.

In operation, the work-piece to be machined is slid into the jig from the left-hand, cut-away end, and inserted in bushing *H*. Nut *F* is then screwed on the threaded end of the work-piece that projects through the locating bushing. This action draws the work-piece toward the shoulder on bushing *H*. However, before contact is made with the bushing shoulder, wedge *J* is fed in by rotating knob *L*. The wedge, acting on the under side of the square shank of the work-piece, forces the work-piece into proper alignment. Nut *F* is then tightened to bring the work-piece against the bushing shoulder, and the drilling and reaming operations are performed.

Milling Fixture for Odd-Shaped Handle

By ROBERT W. NEWTON, Poughkeepsie, N. Y.

The offset handle shown in Fig. 1 is cast with a compound angle bend. The distance between the lugs shown at *A* must be finished to a tolerance of 0.002 inch and the lugs must be square with the center line of the broached hole. Production is low for this piece, so the milling fixture to finish-machine the surfaces of these lugs had to be as simple as possible, yet hold the work rigidly and accurately.

In the fixture illustrated in Fig. 2, the block for the locator, the block for the jack-screw, and the block for the clamping screw are welded to the base. In order to bring the bottom of the surface to be milled on center, the locator block is welded to the base at an angle as shown in the plan view. The side of this block is chamfered to clear the work-piece.

The hardened locator is a slip fit for the square broached hole in the work-piece, and is chamfered on the end so that the work will go on it easily. Also, to aid in easy fitting of the work on the locator, the sides of the locator are cham-

Fig. 1. Cast offset handle, milled between lugs (A) to a tolerance of 0.002 inch on the fixture shown in Fig. 2

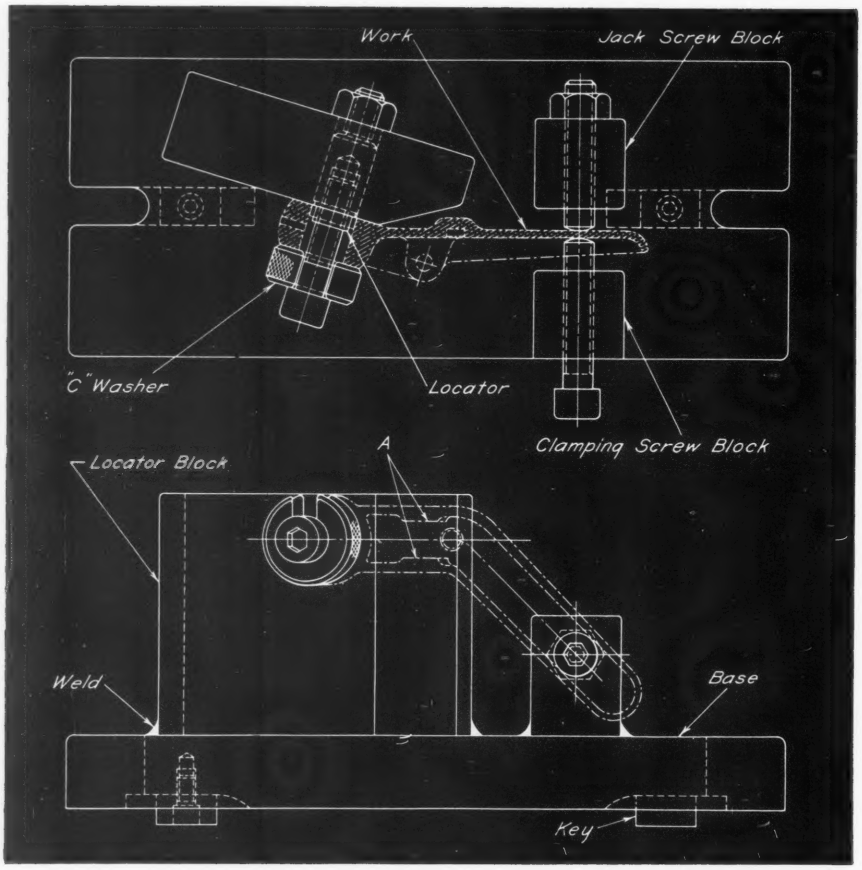


Fig. 2. Milling fixture for an odd-shaped cast handle is of welded construction, and securely clamps the work as shown

fered at the four corners. A shank is ground on this locator to provide a light drive fit for the hole bored in the locator block. The locator is pressed into this hole so that the square is parallel to the base of the fixture. A hexagonal nut is placed on the threaded end of the locator and screwed tightly against the back of the locating block. This locks the locator in position and prevents it from pulling out of the hole. A socket-head clamping screw engages a tapped hole in the square end of the locator.

After a work-piece is loaded on the locator, a knurled C-washer is slipped over the shank of the screw. The screw is then turned until the work is clamped tightly against the side of the locating block. A hole, tapped through the block for the jack-screw at the required location, suits the angle of the work-piece and a set-screw in this hole is set against the web of the casting. It can then be locked in position with a hexagonal check-nut and can be adjusted to suit any variations between different lots of castings. The clamping screw block has a socket-head cap-screw to clamp the work-piece against the jack-screw to prevent chatter.

* * *

The elements of vacuum tubes used in the latest hearing aid models are of nickel filament wire that is only one-tenth as thick as a human hair.

Scarcity of Diamond Powder

The present scarcity and high prices of diamond powder for grinding wheels have been caused by a greatly increased demand in the United States and higher costs of production, and is not the result of alleged planned shortages on the part of Industrial Distributors, Ltd., which distributes 95 per cent of the world's industrial diamonds. This statement was made by L. H. Metzger, president of Super-Cut, Inc., Chicago, Ill., who returned recently from Johannesburg, where a conference was held by the Chemical, Metallurgical and Mining Society of South Africa. In a symposium held during the conference the point was made that every effort is being exerted to alleviate the shortage and reduce prices.

* * *

The nation's political, social, and economic future hinges on how well the engineer's creative force is applied to the efficient use of men, machines, and materials, according to Charles L. McCuen, vice-president and general manager of the Research Laboratories Division of the General Motors Corporation. Mr. McCuen said that the most important single factor in our national economy in the last one hundred years has been the rise of engineering.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

Take Tips from Men of Decision

SALES engineers can go a long way toward selling more and selling better by taking tips from men of decision—responsible purchasing engineers. What do they need? What do they like? What do they think of you and me? These questions have been recently analyzed by a leading magazine interested in buying.

Reading a summary of the opinions of twenty-four men who have worked to the top buying position in large concerns, the following will high-point their advice to us as sales engineers:

1. Match your service and your product to our needs. Focus your selling—the unnecessary "ifs" and "buts" are what we don't like. Be specific in outlining exactly what you and your product can do for us.

2. Approach us with some knowledge of our problem, for we, like you, are busy men. Sense our tough problems. "What do you fellows manufacture anyway?" one incompetent salesman asked, his ignorance automatically blocking his attempt to sell.

3. Conserve our time and your own. Think to telephone us before you call at the office, make a definite appointment. "We try to do business in a positive friendly way, won't you?"

4. Carry in your portfolio information on business trends. Give us up-to-date information along our line of whatever new is going on. Choose those ideas that will help us in our design, manufacturing, delivery, or cost problems.

5. When you come with a presentation, make it clear, concise, and definite. Give us the reasons. "Please! Less idle talk, trivialities, and irrelevant gossip."

6. When you call on us, be well informed on the conditions stipulated in orders already placed with you. "Delivery and performance are part of every sales transaction."

7. Call on us regularly. Our needs change. "Well, what became of you?" asked one purchasing engineer. "Didn't even see you on Ground Hog Day!" Even the best of customers cannot be expected to wait indefinitely for your appearance.

8. Be honest. Don't bluff. When you don't know, say so—but be quick to find out and advise us. "Oh yes, I asked you that a month ago, but didn't hear from you."

9. When we give you an order, don't forget that right then you become an essential link in our own performance, and accordingly, part of us.

10. Include extras—not additional equipment —but extra service beyond requirements. Then we know you are really interested, and broad relationships based on service eventually mean orders to you.

11. Try to anticipate our needs. Keep us posted on new products and new uses. When you see a real opportunity wherein your service and equipment will help us, keep after us, even though we may be slow to respond. Try again, with crystal clear reasons.

12. Above all, have integrity. Don't make impulsive statements which can become embarrassing commitments in the "cold gray dawn." Be sure that you can stand by whatever you promise.

13. We like you if you're on the job, because good industrial salesmen are a two-way street. You are our best source of information. Charles Schwab once said: "No one is more useful to a community than a good salesman."

Can't all of us learn from sound suggestions such as these? If so, we can boost the selling pressure a few points on our performance gage.

LATEST DEVELOPMENTS IN *Shop*

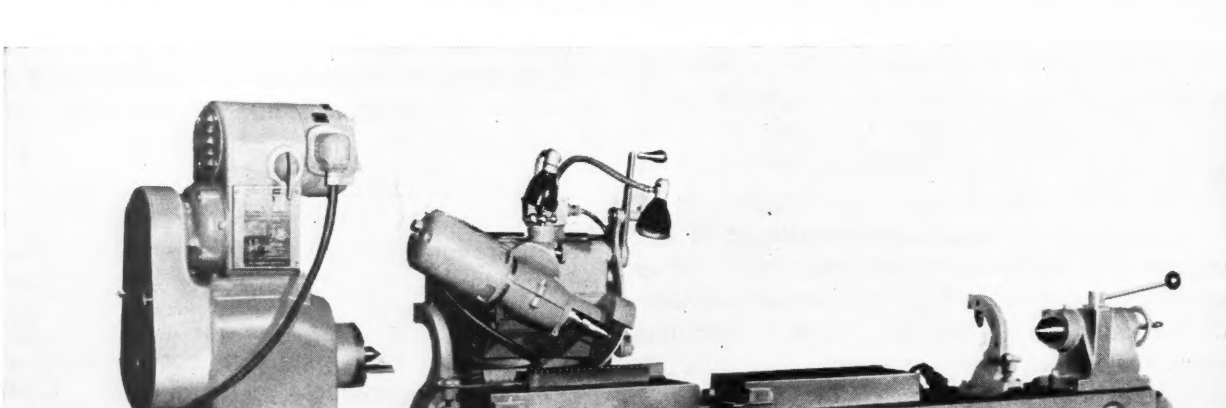
Universal Broach Sharpening Machine

A new universal model broach sharpening machine, designed to sharpen both round and flat type broaches, has been developed by the American Broach & Machine Co., Ann Arbor, Mich. An outstanding feature of this machine is the mounting of the variable-drive headstock, live center tailstock, and intermediate steady-rests on a stationary machine bed of rugged design.

The fixed machine bed offers two distinct advantages: First, the broach is held securely in a rigid position with no chance for misalignment; and second, less floor space is required for the machine. With the broach held stationary, the adjustments for sharpening are made by bringing the grinding wheel into the correct position. This is facilitated by having the grinding wheel spindle mounted on a traversing carriage equipped with micrometer adjustment. The spindle is driven by a 3600-R.P.M. motor, having provision for obtaining speeds which may be as high as 15,000 R.P.M.

Optional equipment for quick conversion to flat or surface broach sharpening consists of a regular Sundstrand magnetic Viking chuck with power unit and demagnetizer.

In order to sharpen a surface type broach, the chuck is simply



Universal type broach sharpening machine developed by the American Broach & Machine Co.

Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

placed on the machine bed and the broach positioned for grinding, the final adjustments being made with the micrometer controls of the grinding wheel spindle. A broach sharpener designed for sharpening round broaches only is also available.

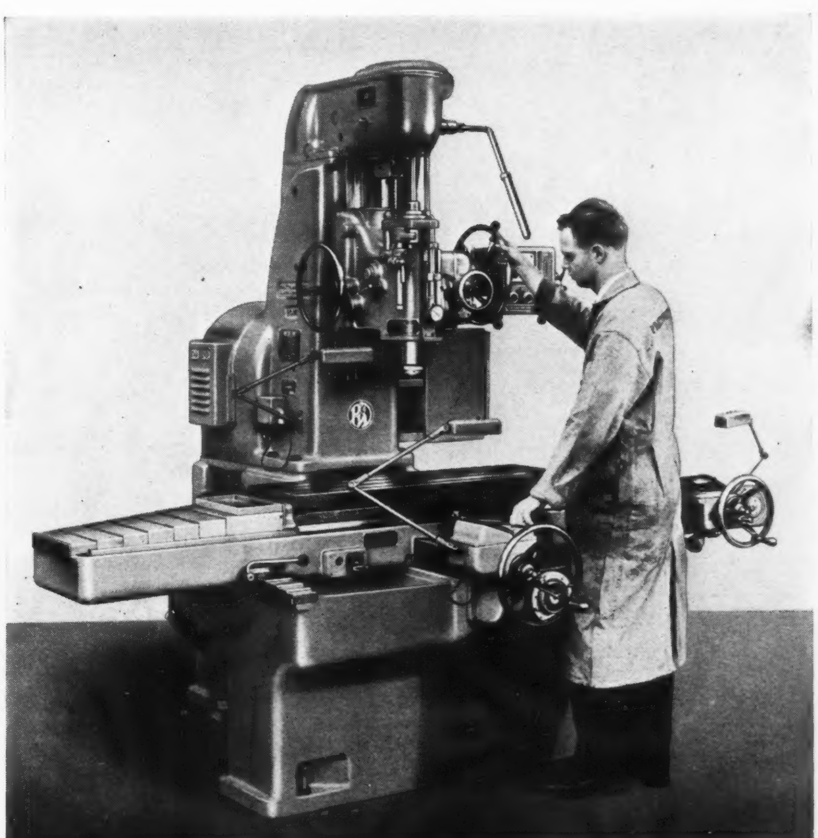
Pratt & Whitney Small Size Jig Borer with "Electrolimit" Measuring System

Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn., has announced a jig borer which is the second model in a series of jig boring machines of completely new design being added to the company's line. This is the smallest of the new machines which feature the "Electrolimit" measuring system, and has been designated the No. 1E. It provides an unusually accurate machine for precision locating, drilling, and high-speed boring in small work. Design improvements in the new machine include a heavier and wider bed construction; table and carriage way telescoping guards; built-in "Electrolimit" measuring system; a new design quill mounting; and a handy control center for faster and easier operation.

Table settings that are accurate to 0.0002 inch can be made quickly with the "Electrolimit" measuring system. Two measuring units, entirely independent of traversing screws, control the longitudinal and transverse settings. Basic 1-inch spacings are obtained electromagnetically from a solid master bar and registered visibly by a zero reading on an indicating meter. Since there is no mechanical contact involved to cause wear, the original accuracy is retained indefinitely. Fractional inches are obtained by moving a small electromagnetic unit between the inch spacings on the master bar with a super-precision micrometer screw. A large, 4 1/2-inch micrometer barrel allows easy reading to 0.0001 inch.

The spindle quill mounting is designed to maintain its initial rigidity and accuracy for the life of the machine. The hardened, ground, and lapped quill "roll feeds" or moves on 300 specially selected precision balls. The balls are pre-loaded between the hardened quill and hardened spindle head bore, and are guided in a staggered distribution pattern by a phenolic bearing cage. The highly sensitive hand feed facilitates precision small-hole drilling.

Spindle speeds and feeds have been increased. The sixteen spindle speeds available range from 65 to 2800 R.P.M., and the four spindle feeds, both up and down, range from 0.0006 to 0.006 inch per revolution. Two table sizes



Small size jig borer with "Electrolimit" measuring system brought out by Pratt & Whitney

are available, increased longitudinal travel being provided on the large size. The 12- by 24-inch table has an 18-inch longitudinal travel and 12-inch transverse travel. The 12- by 42-inch table has a longitudinal travel of 36 inches. Special columns 4 or 6 inches higher than standard can also be furnished to increase the normal 20-inch capacity between table and spindle.

The machine with the smaller size table requires a floor space 66 by 78 inches, is 91 inches high, and weighs about 4000 pounds. The machine with the larger table requires a floor space 106 by 78 inches, is 93 inches high, and weighs about 5000 pounds.

"Red Ring" Rolling Fixture for Checking Gears

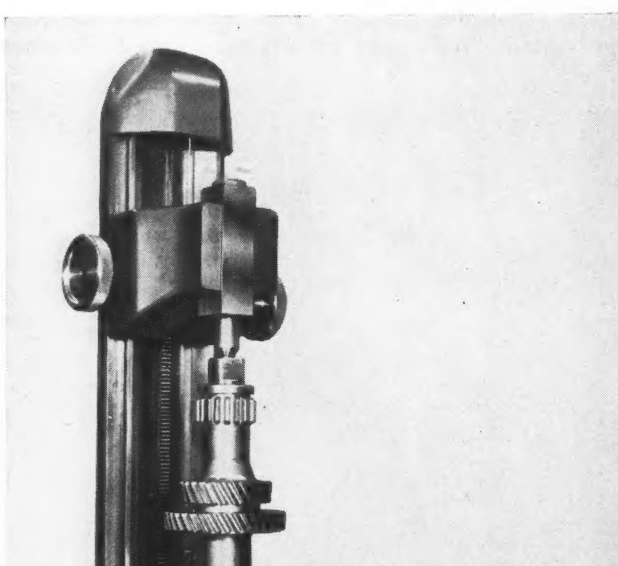
A gear rolling fixture with a column type work-head designed to indicate errors in both size and eccentricity of gears is being marketed by National Broach & Machine Co., 5600 St. Jean Ave., Detroit 13, Mich. This fixture will also reveal any excessive roughness that may be present in the tooth surfaces. The adjustable work-head is set at precisely the correct center distance from the master gear spindle which is carried on a floating spring-loaded slide. This setting is usually made with precision gage discs.

When the work gear is rolled in mesh with the master gear, errors are read directly on a dial indicator actuated by any movement of the master gear slide resulting from inaccuracies in the work gear. The column type work-head assures maximum rigidity. Counterbalancing of the upper center aids in setting up the fixture. Spring-loading facilitates removing and replacing the work. The knob on the right of the column is used to raise or lower the center slide, while the one on the left is used to lock it in place.

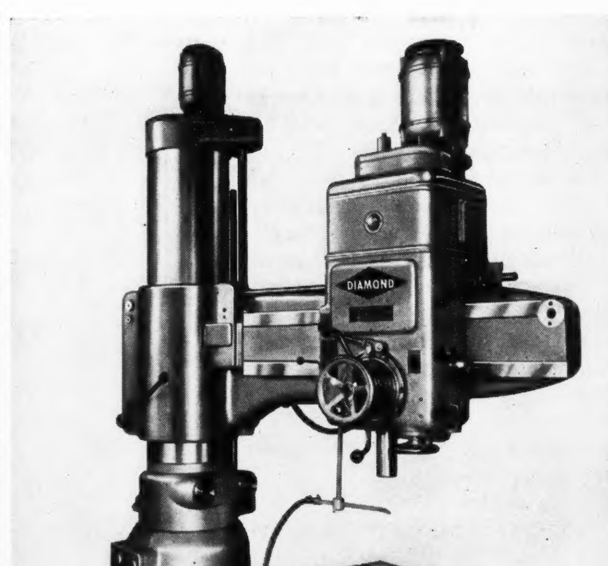
Radial Drilling Machine

The Diamond Machine Tool Co., 3429 E. Olympic Blvd., Los Angeles 23, Calif., has announced a heavy-duty radial drilling machine which is available in sizes from 3 to 8 feet, inclusive. The column and the sleeve of this machine have been made of ample size to withstand heavy stresses even when adjusted to the most unfavorable positions. The arm moves along the sleeve supported by three guiding surfaces.

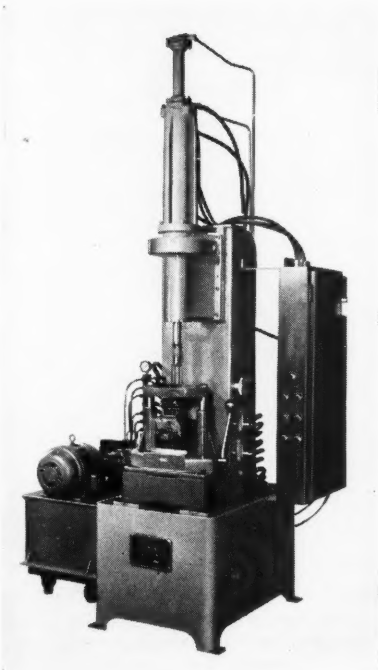
When unclamped, the saddle can be moved by hand, supported by rollers running on a strip of hardened spring steel. The disc clutch in the top part of the saddle permits smooth starting of the drilling spindle, which is a considerable advantage when tapping. When disengaging the clutch, the gear is stopped by an automatic brake. The 4-foot model has a maximum distance from center of spindle to column of 49 1/4 inches and a horizontal spindle traverse of 36 3/8 inches.



Rolling type fixture for checking gears made by National Broach & Machine Co.



Radial drilling machine recently announced by the Diamond Machine Tool Co.



Vertical honing machine added to line of honing equipment made by the Staple Engineering Co.

Vertical Honing Machine

The Model D-12 vertical honing machine has recently been added to the line of machines manufactured by the Staple Engineering Co., Inc., 1315 S. Woodward Ave., Birmingham, Mich. This new machine has a range of 1 1/4 to 4 inches in diameter and a 10-inch stroke. It is electrically controlled and hydraulically operated.

The spindle is driven by spiral gears and V-belts, pick-off sheaves being used for speed changes. A 3-H.P., 1200- or 1800-R.P.M. motor is standard equipment for the spindle drive.

Hydraulic pressure for reciprocating the spindle and for feeding the hone out is supplied by a separate unit driven by a 2-H.P. motor. Honing stones are actuated by hydraulic pressure and are held out to a pre-set size during the "stroke-out" period. This "stroke-out" time may be adjusted from 3 to 120 seconds. The stroking speed is adjustable from 10 to 50 feet per minute.

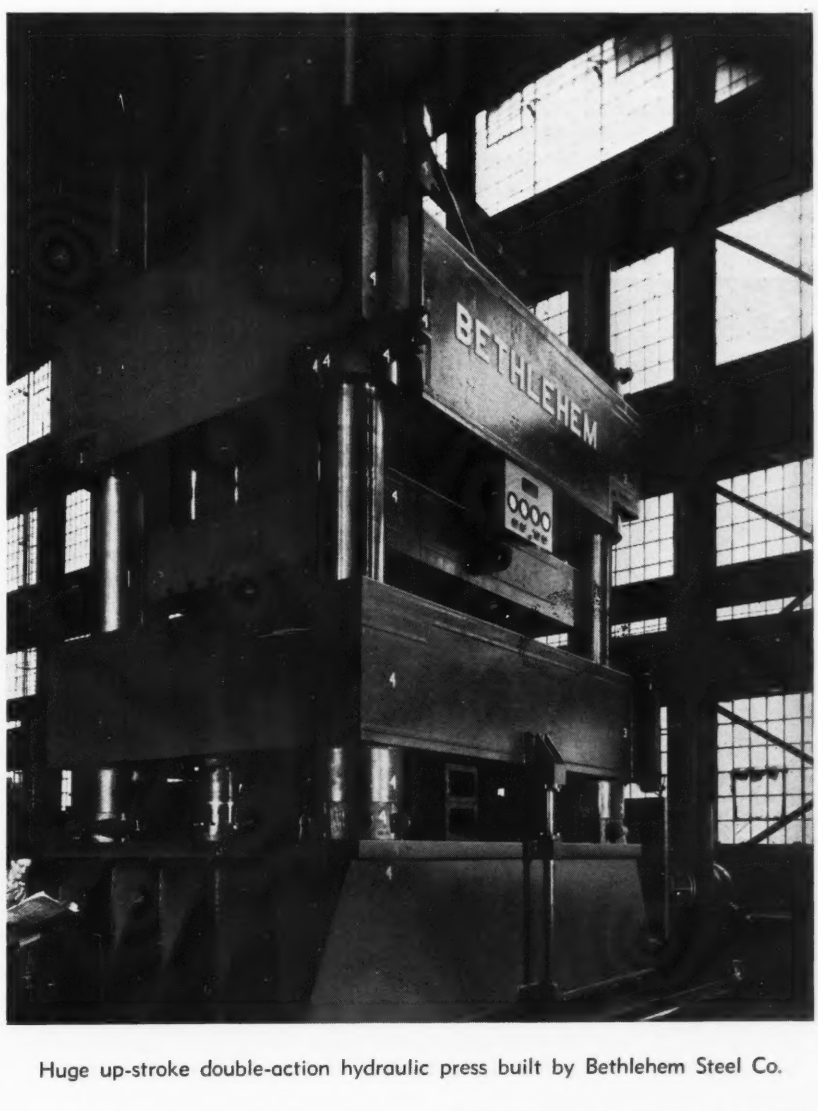
Push-button controls are used for starting, stopping, "inching," and withdrawing the spindle. When set for automatic operation, one button controls the entire cycle, and the machine is shut off automatically when the cycle is completed. The coolant pump and tank are a separate unit and fit into the base of the machine. This unit may be withdrawn to facilitate cleaning. A 1/4-H.P. motor drives the coolant pump. The hydraulic oil capacity of the machine is 30 gallons.

Bethlehem 4000-Ton Up-Stroke Hydraulic Press

The Bethlehem Steel Co., Bethlehem, Pa., has designed and built a 4000-ton up-stroke double-action hydraulic press for a railway equipment manufacturer. This press can be operated as a single-action unit by clamping the blank-holder to the top platen. For double-action operation, adjustments can be made for any blank-holder pressure from zero to 1000 tons. The blank-holder suspension rods also have adjustable stops for limiting the blank-holder stroke up to 24 inches. The maximum stroke of the press is 48 inches.

The press has a main ram 58 inches in diameter and two smaller lifting rams. It operates on a primary pressure system of 1500 pounds per square inch, which can be boosted to 2250 and 3000 pounds per square inch through two intensifiers. It exerts a force of 2000, 3000, or 4000 tons, either by using the pressure from the line system or by increasing the pressure with the intensifiers, which operate by means of automatic valves. Use of the intensifiers is selective.

The daylight capacity is adjustable by raising or lowering the upper platen, this being done with the movable platen and blocking. An ejector with a capacity of 150 tons is located in the movable platen. The up-stroke design is said to greatly simplify piping and control of the adjustable daylight system.



Huge up-stroke double-action hydraulic press built by Bethlehem Steel Co.

The press has an over-all height of about 33 feet, including a basement section. In hot-forming various railroad car body parts, it will operate at a speed of 2 1/2 pressing cycles per minute. Of heavy welded construction, it was designed to meet exacting requirements of the customer regarding platen deflections. The estimated weight of the press is about 978,000 pounds.

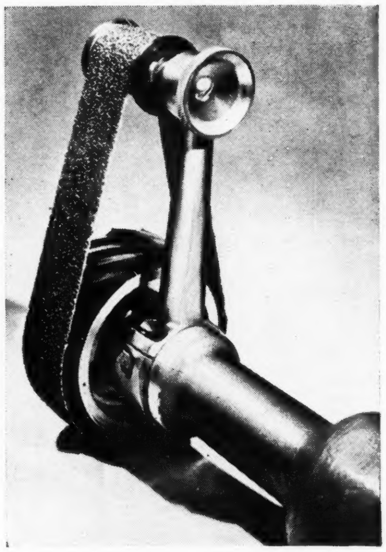
Cross Special Machine Tool Designed to Speed Up Production of Tank Parts

The production of tank parts is said to have been speeded up by a special machine tool recently designed and built by The Cross Company, Detroit 7, Mich. The machine drills, chamfers, and taps four holes; and drills, chamfers and reams one hole in intermediate and rear wheel arms. These cast armor parts have a hardness of Rockwell C-35. A production of thirty-two right-hand and thirty-two left-hand arms—a total of sixty-four pieces an hour—is claimed for the machine. This is accomplished through a unique duplex work-holding fixture which holds one right- and one left-hand part in each station.

The machine has a six-station power-operated dial indexing table. One station is used for loading, two for drilling, one for chamfering, one for reaming, and one for tapping. The table is rotated by a fluid motor drive. Hydraulic and electrical construction is in accordance with Joint Industry Conference Standards. Other features include hardened and ground ways, hydraulic feed and rapid traverse, individual lead-screw feed for tapping, and "Sav-A-Tap" spindle construction.

Belt Grinding Attachment for Portable Tools

An attachment which permits abrasive belts to be used on straight spindle air and electric portable tools has just been announced jointly by The Carborundum Company, Niagara Falls, N. Y., and the Buckeye Tool Corporation, Dayton, Ohio. This belt grinding attachment offers the possibility of a completely new range of applications for portable tools.



Belt grinding attachment for portable tools, announced by The Carborundum Company and the Buckeye Tool Corporation

The attachment, made from light-weight aluminum castings, consists of an idler pulley, the supporting mechanism, and a contact wheel—the latter being mounted on the tool spindle. The contact wheel is a small-sized version of the serrated "61" wheel made by The Carborundum Company for back-stand belt grinding and polishing operations. The unit is attached by a split bracket to the casing of the tool where grinding wheel guards are nor-

Machine developed by The Cross Company for rapid production of tank parts

mally mounted. This bracket makes the attachment adaptable to almost any portable tool of the proper speed and type.

The attachment is now available in two models. Excellent results in field tests of these units were obtained using a Buckeye Series C grinder with a 2- by 1-inch contact wheel and a Buckeye Series D grinder with a 4- by 2-inch wheel, these tools delivering constant spindle speeds of 15,000 R.P.M. and 9000 R.P.M., respectively. Speeds from 5000 to 10,000 surface feet per minute are recommended for efficient belt usage wherever possible. Initial belt sizes for these two models are 12 by 1 inch and 20 by 2 inches. A wide variety of grit sizes and backings may be used.

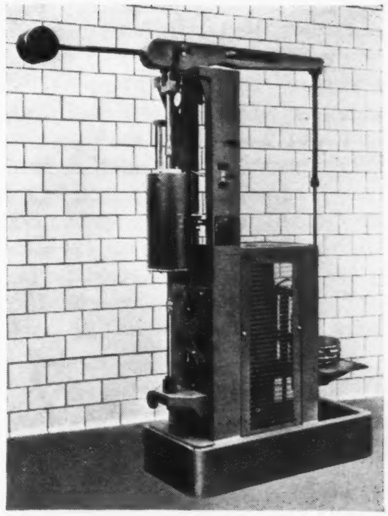
Taylor-Winfield Multiple-Seam Welder for Joining Aluminum Channels and Plates

The Taylor-Winfield Corporation, Warren, Ohio, has announced the development of a new multiple-seam resistance welder for a leading refrigerator manufacturer. This welder is designed for use in making the liner for the cold wall of the low-temperature refrigeration compartment by welding aluminum to aluminum. As the 0.032-gage, 13- by 60-inch plate travels through this machine, six formed aluminum channels, 3/8 inch wide by 60 inches long with 1/2-inch legs, are welded to the plate in a simultaneous operation. These channels hold the metal tubing through which the refrigerant is passed to extract heat from the low-temperature compartment.

A time-saving feature of this welder is the multiple high-speed wheel-dressing unit which removes the aluminum picked up on the copper welding wheels. The entire welder is 32 feet long. One operator and one assistant can load and unload the work. The approximate rate of operation is 120 panels per hour.

Creep Testing Machine for Special Alloy Steels Used in Jet Engines

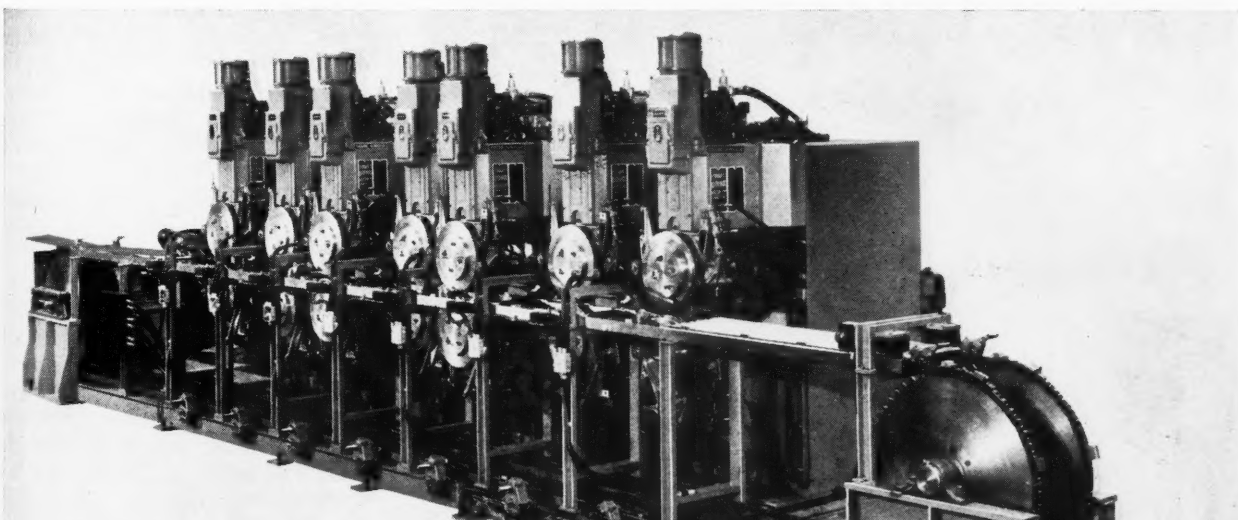
A lever-arm creep testing machine of 12,000-pound capacity has been developed by the Heppenstall Co., Pittsburgh, Pa., for use in testing its special alloy steels used in high-temperature applications, such as jet engines and gas turbines. This equipment —known as the "Arcweld" ma-



Machine developed by Heppenstall Co. and built by Arcweld Mfg. Co. for creep-testing special steels

chine—is manufactured by the Arcweld Mfg. Co., 140 46th St., Pittsburgh 1, Pa. It has a power-operated lifting mechanism for the weights used for loading specimens. During testing, the lifting platform automatically positions itself about 1/2 inch below the weight pan so that the shock of dropping weights is minimized when the specimen breaks in stress-rupture tests.

For testing at temperatures up to 1800 degrees F. an exceptionally large furnace with three



Multiple-seam welder for aluminum developed by the Taylor-Winfield Corporation

heating zones is provided. Temperatures in the three zones can be individually regulated. Temperature control equipment is mounted on a stainless-steel panel, and can be removed as a unit. When used in conjunction with one type of standard controller, specimen temperature can be held within 1 degree F. at 1200 degrees F. for long periods. Unloaded, the machine weighs 1000 pounds.

Car type heat-treating furnace placed on the market by the Waltz Furnace Co.

Car Type Heat-Treating Furnace

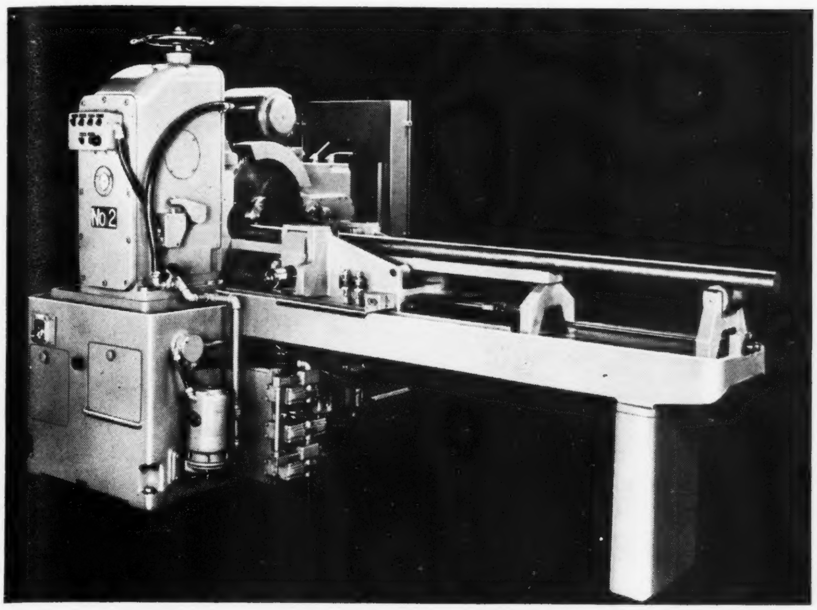
A car type heat-treating furnace has been built by the Waltz Furnace Co., 1901 Symmes St., Cincinnati, Ohio, to meet the special requirements of the Cincinnati Shaper Co. for stress-relieving treatment of gears, castings, flame-cut pieces, and similar parts. This furnace has a temperature range from 800 to 1750 degrees F., and is fired by eight North American burners, four on each side of the furnace, one side overfiring and the other side underfiring to maintain uniform heat distribution throughout the furnace. Inside dimensions of the furnace are 42 inches wide by 72 inches long. There is a clearance of 2 feet between the bottom of the furnace door and the top of the fire-brick facing laid in the car bed. Regulators provide for accurate control of temperature.

Clausing Improved Lathe

The Clausing Division, Atlas Press Co., 2353 N. Pitcher St., Kalamazoo, Mich., has announced that several refinements have been incorporated in two series of lathes. The 6300 series illustrated has a forged, ground steel spindle, with 1-inch collet capacity, A.S.A. —L-00 tapered key drive nose, and Timken tapered roller bearing equipped spindle and lead-screw. Outboard drive with dual A-belts serves to drive the spindle pulley. Countershaft or variable-speed drive is optional. These drives give spindle speeds of 50 to 1300 and 30 to 1400 R.P.M.

The 4800 series has a Timken tapered roller bearing equipped spindle. This spindle has a 1/2 inch collet capacity. The built-in countershaft has a friction clutch and brake. All quick-change gear-shafts are ball bearing equipped. The two V-ways and two flat ways of the heavy bed are precision ground. These lathes are made in three lengths of 24, 36, and 48 inches between centers. The swing capacity is 12 3/4 inches over bed and 7 1/2 inches over saddle. Quick-change gear-box provides instant selection of 48 threads ranging from 4 to 224 standard, right- or left-hand.

Lathe of improved design announced by Clausing Division, Atlas Press Co.



Motch & Merryweather circular cutting-off saw with new stock feeder

Circular Sawing Machine with New Stock Feeder

The standard No. 2 circular sawing machine manufactured by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio, can now be equipped with a stock feeder, designed to automatically feed bar stock used for shell forgings. This automatic stock feed has two heavy-duty, hardened, serrated feeder grippers mounted on a slide. The bar stock to be cut off is positioned on the supporting V-channel under the hydraulically actuated vertical vise for the initial cropping or squaring cut. Thereafter, the feed is automatic. The grippers clamp the stock, and the entire slide, operating between positive stops, moves the stock forward the distance required for cutting work to the correct length.

As soon as the stock is clamped in the vise, the grippers release the work, the slide moves to the rear stop, and then the grippers reclamp the work. Both the slide movement and clamping action are actuated by hydraulic cylinders. Parts subject to wear are hardened and ground, and automatic lubrication is provided for sliding surfaces.

Production can be increased by positioning a bar on the supports before the cutting-off operations on the preceding bar have been completed. The feeder will handle round stock from 1 inch to 6 1/2 inches in diameter, using any feed length from 1/4 inch to 36 inches.

Improved Line of "Shear-Speed" Gear Shapers

An improved line of "Shear-Speed" gear shapers is announced by Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich. Twelve new design features have been incorporated in these machines to provide improved performance, reduce tool changing time, and facilitate machine maintenance. A Model 18105 with a 5-inch cutter head stroke replaces the former Model 18103 which had a 3-inch maximum stroke.

The Series 1800 line now includes four models which have capacities for handling gears ranging from 1 inch to 10 inches in diameter with maximum face widths ranging from 2 3/4 to 4 1/2 inches. The line is designed for cutting spur gears; involute, angular, straight-sided, and inverted splines; sliding clutches; toothed parts; ratchets; and pieces having special forms.

Design improvements include a standard adjustment ring for con-

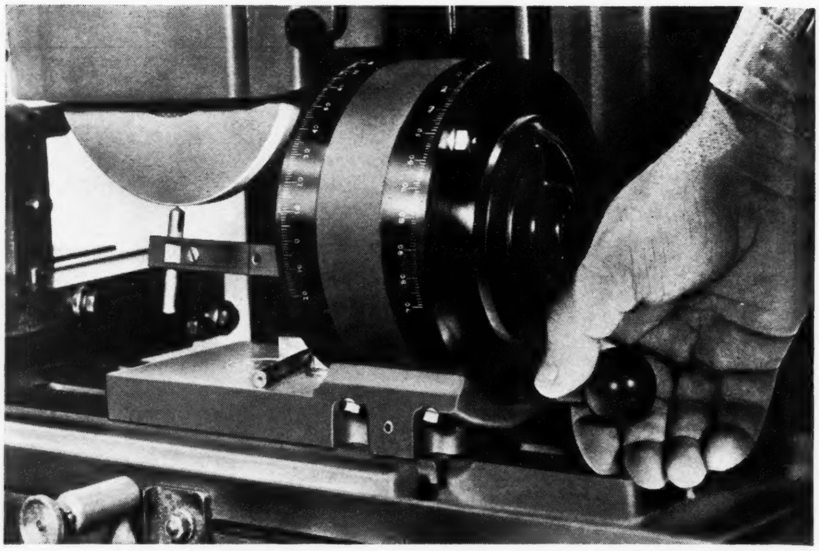
Michigan "Shear-Speed" gear shaper of improved design

trolling tooth spacing which has two indicators to facilitate tool setting; an air cylinder in the cutter-head which clamps work in the fixture and pilots moving parts into the base to insure positive alignment; coolant and lubricating pumps mounted outside the machine base for accessibility; gages and relief valves on the lubricating pump that permit observation and control of lubricating system; handwheels that replace ratchet mechanism to reduce time required to remove and replace cutter head; a main hydraulic cylinder that moves the head into position (which has been redesigned to prevent leakage and facilitate head removal and replacement); two rest plates, one at each side of the cutter-head; and non-flare hydraulic fittings. The hydraulic control panel and electrical control panels meet J.I.C. specifications.

Huge Metal-Cutting Band Saw for Trimming Airplane Stampings

A band saw of huge size has been manufactured by the Tannewitz Works, Grand Rapids, Mich., for use in conjunction with a 50,000-ton press, for trimming the edges of complete airplane wing stampings. This band saw has a table 8 feet 8 inches wide by 10 feet long, and is equipped with two regular 36-inch wheels above and below the sawing area and another wheel of 30-inch diameter in the column at the end of the table. Power for driving the machine is furnished by a 15-H.P. motor equipped with multiple V-belt drive.

Giant size band saw for trimming airplane wing stampings, built by Tannewitz Works



Wheel-truing attachment recently announced by the Brown & Sharpe Mfg. Co.

B & S Continuous Radius and Tangent Wheel-Truing Attachment

A wheel-truing attachment designed to form, with one continuous movement of the diamond, accurate radii on grinding wheels with accurate tangents at either or both sides of the radii has been brought out by the Brown & Sharpe Mfg. Co., Providence 1, R. I. Convex radii up to 1/2 inch with tangents up to 5/8 inch in length at any angle, from 90 degrees above horizontal to 20 degrees below, can be formed. Concave radii from 5/32 inch to 1 inch with tangents up to 5/8 inch long at any angle, from 90 degrees below horizontal to 20 degrees above, can also be formed. The angles of the tangents are independent of each other. On a concave shape the included angle must be 90 degrees or more.

The attachment is clamped firmly to the machine table by only one T-bolt. Accurate alignment is assured by two reversible tongues for T-slots 1/2 inch or 9/16 inch wide. These tongues are easily removed when the attachment is to be used on a magnetic chuck.

When truing a convex form, the angle of the tangent at the front of the wheel is controlled by the angular setting of the adjustable plate at the left-hand side of the attachment body; the angle of the tangent at the back of the wheel is controlled by the setting of the plate at the right-hand side of the body. When truing a concave

form the left-hand plate controls the rear tangent and the right-hand plate the front tangent. Verniers on the plates and matching scales on the attachment body facilitate the setting. Two clamp nuts on each plate maintain the angular setting. A gage used in conjunction with a micrometer permits setting the diamond to form an accurate radius on the grinding wheel.

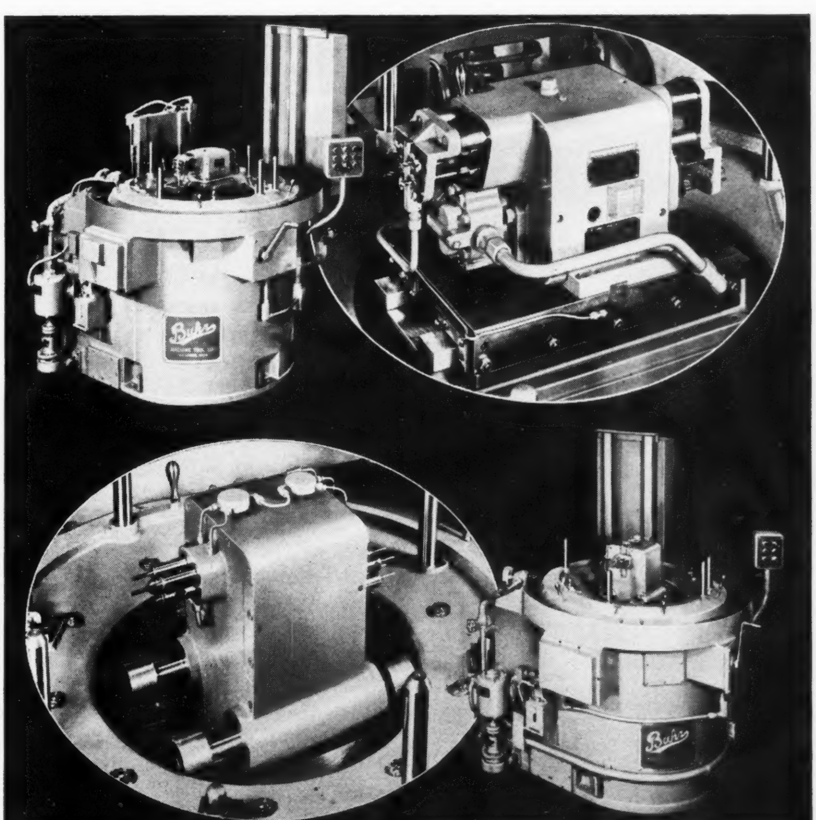
After the attachment is properly set, the diamond is brought into contact with the grinding wheel and the wheel is accurately formed to the desired shape by turning the easily operated crank at the right. The attachment weighs approximately 30 pounds.

Buhr Special Machines Designed to Drill and Tap Blind Holes in Jet-Engine Supports

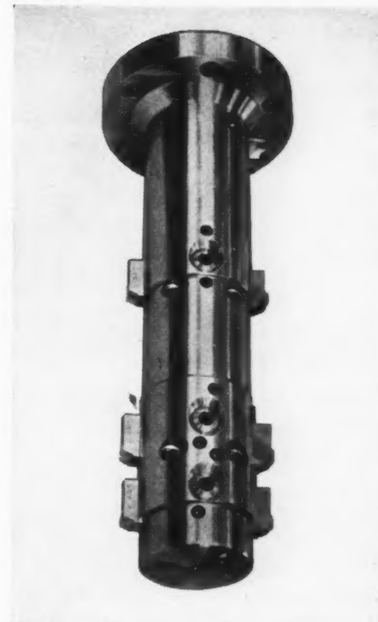
Two special machines have been built by the Buhr Machine Tool Co., Ann Arbor, Mich., for use in drilling and tapping operations on jet-engine bearing supports. These machines drill and tap twenty-four blind holes—all unevenly spaced, at different levels on the inside of the bearing support, and in a working area too small to permit the use of a conventional type drilling unit.

The machine illustrated in the upper view is equipped with a reciprocating drill head, which is seen in the close-up view at the right. This drill head is mounted on a hydraulically operated way type slide, and includes four drill spindles at each end driven by a hydraulic motor. By using this driving method, the proper speed for the tools can be easily selected simply by controlling the speed of the hydraulic motor.

Each machine is also equipped with a special rotary table which features irregular spacing. However, the table is electrically interlocked in such a way that the holes can be drilled only in their proper relative positions. The tapping machine shown in the lower view functions on the same principle as the drilling machine, except that the taps are driven by a master lead-screw. Close-up view at left shows tapping head.



Special drilling and tapping machines built by Buhr Machine Tool Co. for drilling and tapping bearing supports for jet engines



Car wheel boring tool manufactured by the Davis Boring Tool Division, Giddings & Lewis Machine Tool Co.

Davis "Three-in-One" Car Wheel Boring Tool

A "Three-in-One" car wheel boring tool has been made by the Davis Boring Tool Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., for use in railroad repair shops for boring cored hub wheels. Boring problems caused by the core openings which tend to deflect bar travel are said to be eliminated by this new tool. Unusual machine wear due to such deflection in this type of boring is also claimed to have been entirely eliminated.

Successful operation of this boring tool is made possible by a set of extra cutters located between the first roughing cutters and the final finishing cutters. These intermediate cutters provide for continuous cutter contact in the bore during the boring cycle regardless of the cored openings in the wheel hub. The cutters actually support the boring tool in the bore, lending rigidity to both the bar and machine ram. This, in turn, prevents deflection, which might cause serious ram distortion and cutter breakage.

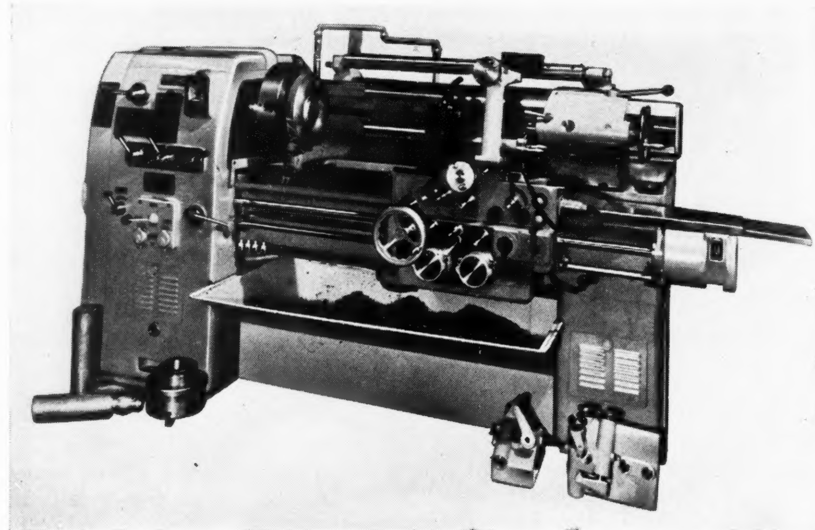
The tool is equipped with Davis micrometer expansion blocks having blades of solid tungsten carbide. The body of the tool is made of high grade chromium nickel steel and is precision machined throughout.

Adjustment of cutters to required bore size within 0.001 inch is easily made by means of a graduated screw operating an expanding wedge. As much as 1 1/8-inch diametrical adjustment is possible. Thus a wide range of bore diameters is readily obtainable with each size of boring tool.

Reinecker Internal and Face Grinding Machine

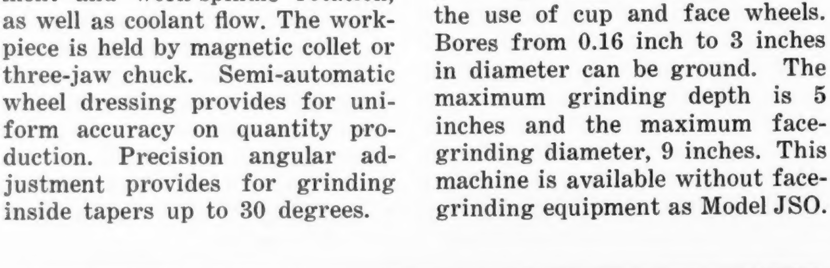
Internal and face grinding operations can be performed in a single setting of the work-piece in the Reinecker Model JSOP machine now being distributed by the Kurt Orban Co., Inc., 205 E. 42nd St., New York 17, N. Y. By combining both operations in one set-up, the time required for rechucking and centering is saved and a ground face which is true with the bore is assured.

Single-lever control is provided for rapid travel, grinding movement and work-spindle rotation, as well as coolant flow. The work-piece is held by magnetic collet or three-jaw chuck. Semi-automatic wheel dressing provides for uniform accuracy on quantity production. Precision angular adjustment provides for grinding inside tapers up to 30 degrees.



"Sensitast" copying lathe introduced in this country by the Cosa Corporation

The infinitely variable table feed and the grinding wheel infeed are hydraulically actuated. The hydraulically operated face-grinding bracket is adaptable for the use of cup and face wheels. Bores from 0.16 inch to 3 inches in diameter can be ground. The maximum grinding depth is 5 inches and the maximum face-grinding diameter, 9 inches. This machine is available without face-grinding equipment as Model JSO.



Reinecker internal and face grinding machine introduced by Kurt Orban Co.

"Sensitast" Copying Lathe for Outside or Inside Forms

A lathe with a unique copying device controlled by electromagnetic clutches, which will make 90-degree cuts on the left or right side of a work-piece, is being introduced by the Cosa Corporation, 405 Lexington Ave., New York 17, N. Y.

This "Sensitast" copying lathe is made by Heid, Vienna, Austria. It is designed to copy practically any outside or inside form. The traverse and longitudinal feeds operate at the same rate to produce a smooth, uniform finish on the entire work-piece. To obtain a higher degree of finish, a feed reducer with magnetic clutch control is employed. Extremely heavy cuts can be made because of the unusual headstock design and the heavy, rigid construction of the machine frame.

The inverted vee ways, flooded with oil at all times, and the lead-screw and rack are inside the bed and covered with telescopic steel plates for protection against chips and dirt. The tailstock, steady-rest, and template are supported on vertical ways at the rear of the machine. This permits the tailstock to pass over the saddle without interference. The lathe has a 17-inch swing over the cross-slide, 28-inch swing over the saddle, and 37-inch swing over the bed cover. Work up to 39 inches in length can be held between the lathe centers.

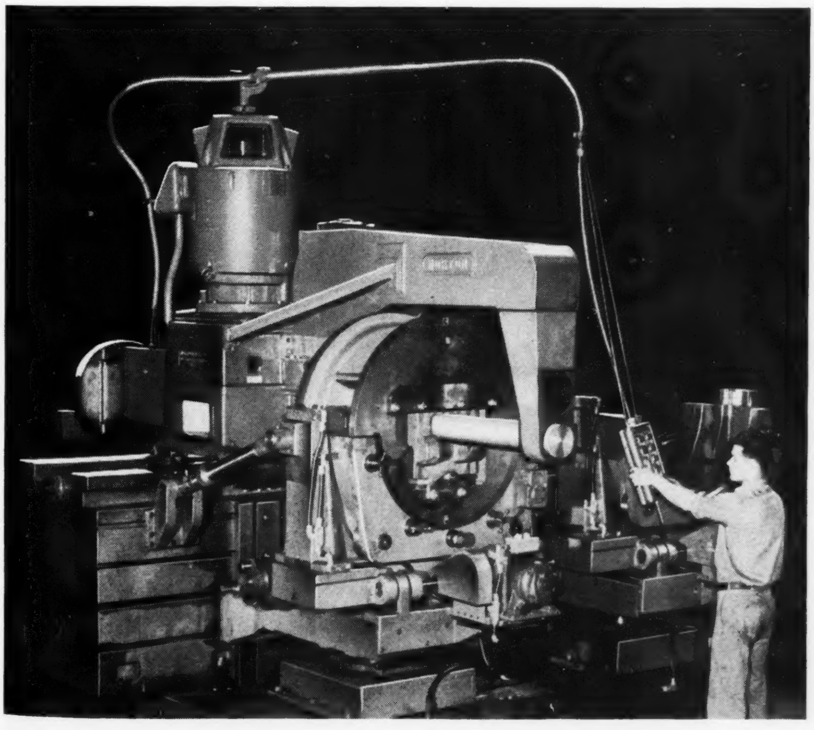
Reliance Motors of Rapid-Reversing and Totally Enclosed Dual-Cooled Types

The development of a direct-current motor to meet the quick reversing requirements of modern high-production machines is announced by the Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio. This motor, shown in the accompanying illustration applied to a draw-cut shaper, makes use of two electronic circuits to momentarily impose several times the normal voltage on both motor armature and field. Controlled within predetermined current limits, these circuits permit the motor to be reversed more rapidly than was previously possible while maintaining maximum torque. Also, the point of reversal is consistently maintained because of a minimum of overtravel. These features provide full cutting power and rapid reversals as required for machining slots in large castings.

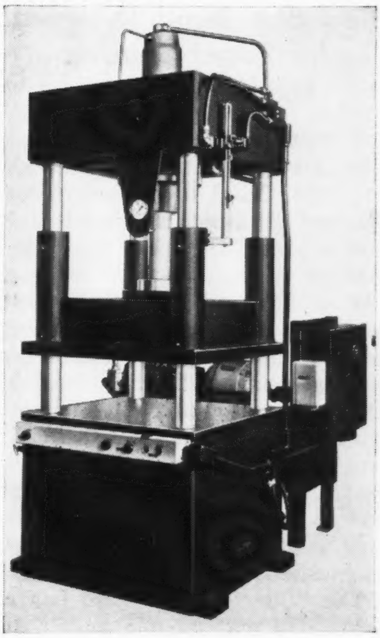
The motor with its generator and electronic controls will be available in sizes from 1 to 500 H.P. Motors in all sizes are force ventilated by an integrally mounted blower. The motor incorporates a number of improvements designed to increase its torque capacity and operating efficiency.

The company has also announced a totally-enclosed dual-cooled motor for use where relatively large power units are required to operate in locations that necessitate extra protection from atmospheric conditions. Adjustable-speed drive motors for such purposes must operate over an extremely wide speed range. A range of from 200 to 1800 R.P.M., for instance, is becoming increasingly common and speed ranges of as much as 100 to 1 are already being used in modern industrial processes.

The motor is equipped with a heat exchanger as an integral part of its own frame. It has a separate 1 1/2-H.P., three-phase, 60-cycle 3600-R.P.M. motor built into the heat exchanger which drives internal and external fans independently of the main motor. Heat exchanger sections of cast aluminum have both internal and external fins for maximum heat dissipation. Air is forced through the internal sections of the exchanger at a velocity of 2900 feet per minute. In the external path between the cover and the exchanger bank, the air is pumped at a velocity of 3300 feet per minute. These motors are available in sizes up to 150 H.P.



Draw-cut shaper equipped with Reliance rapid reversing direct-current motor with electronic controls



Press for molding reinforced plastics built by the Dake Engine Co.

Dake Guided Platen Press for Molding Reinforced Plastics

Special guided platen presses for molding reinforced plastics have been developed by the Dake Engine Co., Grand Haven, Mich. These presses are electrically powered and hydraulically operated. Dual palm-operated switches assure safety for the worker. When contacts are made, the movable platen advances quickly to the work, then just before contact with the work it slows down automatically under the control of a limit switch with adjustable stroke. Heated platens can be furnished if needed.

An adjustable pressure switch limits the pressure applied during the cure to any desired amount from half to full rated load of the press. An electric timer retains this pressure for the duration of the curing cycle—adjustable from 12 to 400 seconds. At the end of the cycle the movable platen returns automatically to the starting position.

Standard press capacities range from 25 to 300 tons. Presses can also be built to meet specific requirements. For example, presses can be built for operation by air instead of electric power. They can also be made with upward-acting movable platens and platens of different sizes.

New Saw Band Designed for Faster Cutting and Longer Life

A "Claw Tooth" saw band has been brought out by the DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill., which has a positive rake angle at the tooth tip. The positive rake gives the teeth a hooked, claw-like form which facilitates tooth penetration and actually "pulls" the saw band into the material so that less feeding pressure is required. This characteristic results in extra fast cutting of fibrous materials—including wood and wood products, as well as plastics—and of non-ferrous metals and alloys such as magnesium, brass, and aluminum.

The "Claw Tooth" band has a hard edge and flexible back. It is not intended for resharpening because of the extreme hardness of its cutting teeth, which is said to make it cheaper to replace the bands than to resharpen them. The bands are available in seven standard widths ranging from 1/4 inch to 1 1/2 inches, with tooth pitches of 2, 3, 4, and 6. They are supplied in 100- and 500-foot lengths in "strip-out" containers, or in convenient cut and welded lengths ready for immediate use on a band machine. These saw bands can be used on machines manufactured by The DoAll Co. or on any standard band sawing machine.

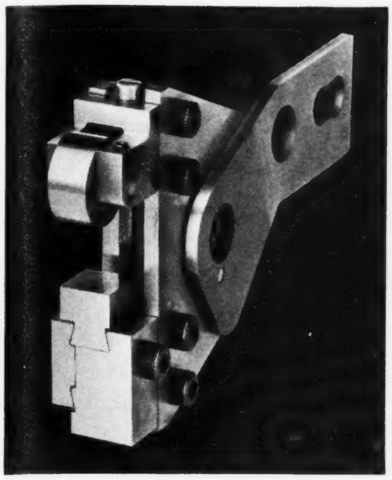
"Claw-Tooth" saw band recently brought out by the DoAll Co.

Polishing Machine for Jet-Engine Blades

A jet-engine compressor blade polisher to meet the need for polishing the airfoil section of jet-engine compressor blades on a high-production, low-cost basis has been built by Hammond Machinery Builders, Inc., 1600 Douglas Ave., Kalamazoo, Mich. This machine, called the Model K-46-6, has six reciprocating blade holders mounted on an indexing turret. Each blade is indexed and automatically polished longitudinally by five abrasive belt heads located around the indexing turret. This arrangement permits the use of a finer abrasive grit at each successive position throughout the work cycle.

One idle reciprocator station is provided for unloading the polished blades and loading the rough blades. Indexing is instantly and infinitely variable to permit the production of 150 to 800 blades per hour at a finish of 4 micro-inches and up.

Machine for polishing jet-engine compressor blades announced by Hammond Machinery Builders, Inc.



Shaving tool for automatic screw machines brought out by the Jersey Mfg. Co.

"Jemco Little Shaver" Finishing Tool

The Jersey Mfg. Co., 401 Livingston St., Elizabeth 27, N. J., has recently added a "Jemco Little Shaver" to its line of cutting tools. This tool is designed for use in obtaining finishes on production work which must be held to tolerances of ± 0.00025 inch. It is adapted for shaving and forming parts that cannot be readily produced by ordinary circular form tools. The tool will fit the standard circular form toolholder or the back slide of a Brown & Sharpe automatic screw machine, and with slight modification it can be used on other automatic screw machines, hand screw machines, and turret lathes.

Standard rise cross-slide cams can be used with this shaving tool; cuts can be taken to the center of the work-piece using standard adjustment without cutting down the cam. The shaver is made in two models—the "Standard" and the "Special" and in three sizes—00, 0, and 2. The "Standard" model has the roll supported on both sides, making it ideal for long runs and long formed pieces. The "Special" model permits shaving close to the chuck, as the roll is supported on only one side. This model is used for forms having considerable difference between the largest and smallest diameters.

Mall Pneumatic Angle-Head Drill

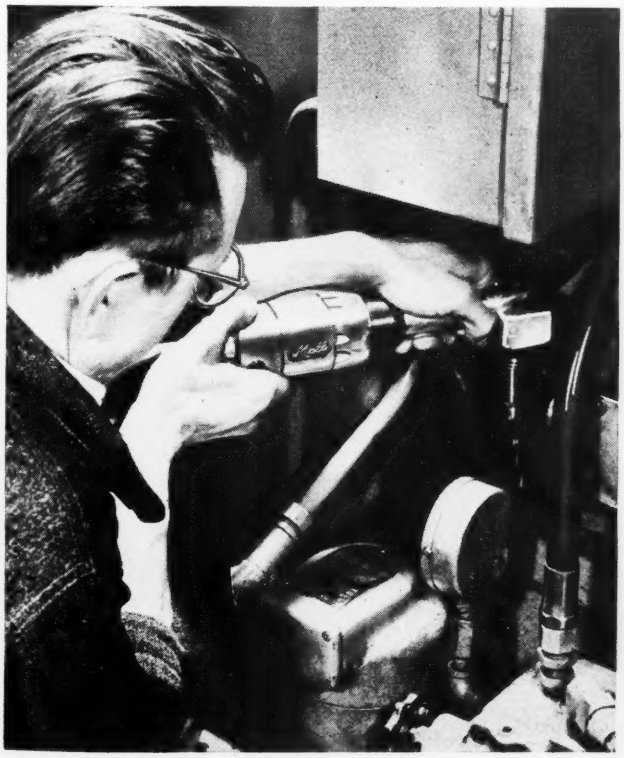
A lightweight air-powered 1/2-inch angle drill with the head designed to allow better access to hard-to-get-at places has been developed by the Mall Tool Co., 7740 S. Chicago Ave., Chicago 19, Ill. The especially small, compact angle-head can be swiveled to any position relative to the throttle by simply loosening a single nut. This feature provides for greater operating flexibility.

A built-in regulator allows for variable speed ranges, while proper lubrication is assured by a built-in automatic oiler. This drill is furnished with a 1/2-inch capacity Jacobs geared chuck and key, hydraulic fitting, and rubber air hose assembly in a lever throttle or button throttle style.

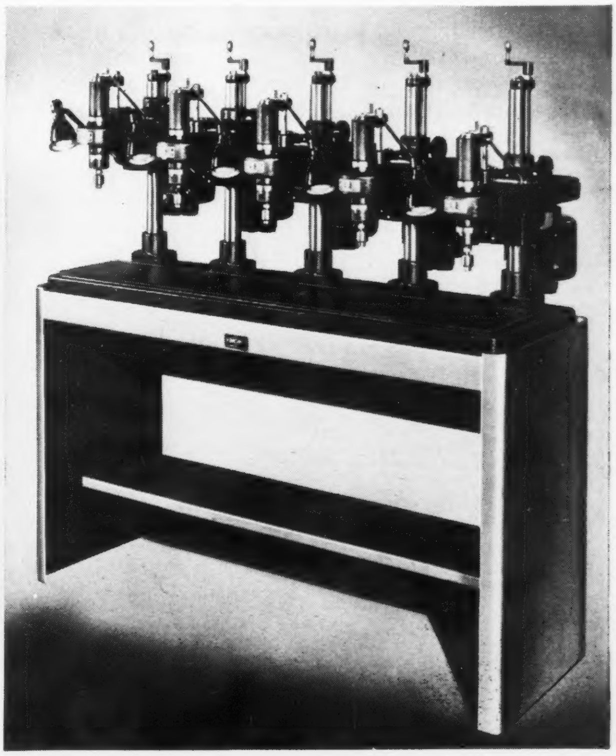
Multiple-Spindle Machines for Precision Drilling of Small Holes

The Hamilton Tool Co., 834 S. Ninth St., Hamilton, Ohio, has announced that its super-sensitive, small-hole precision drilling machines are now available in single-base, multiple-spindle design. These machines have capacities for drilling holes of from 0.004 to 5/16 inch in diameter. The clearances from center of chuck to column range up to 8 inches, while clearances from base to chuck range up to 14 inches.

Adjustable stops are provided on all machines for the precision

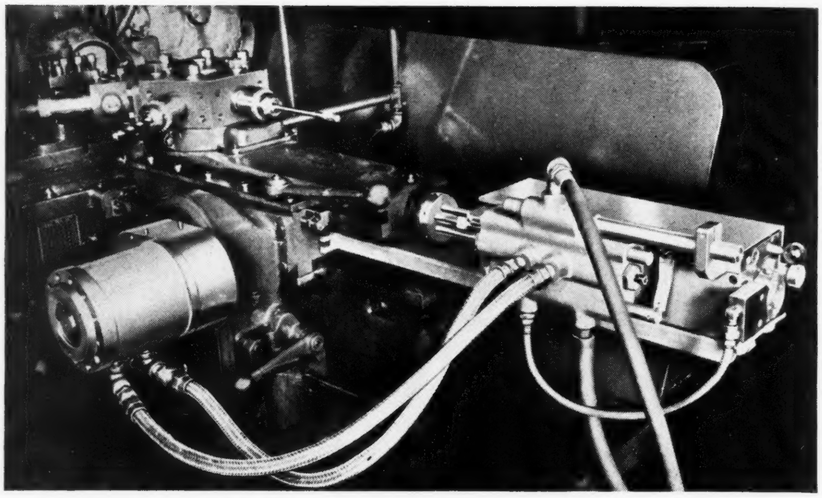


Angle-head drill for close-quarter drilling developed by the Mall Tool Co.



Multiple-spindle pecision drilling machine announced by the Hamilton Tool Co.

control of hole depth, and one model has spindle speeds which are variable between 840 and 9300 R.P.M., controlled by a handwheel type graduated speed dial. Accurately finished continuous base pads on these machines facilitate the use of box fixtures.



Ram type turret equipped with new Viking hydraulic turret drive

Viking Hydraulic Drive for Ram Type Turrets on Hand Screw Machines

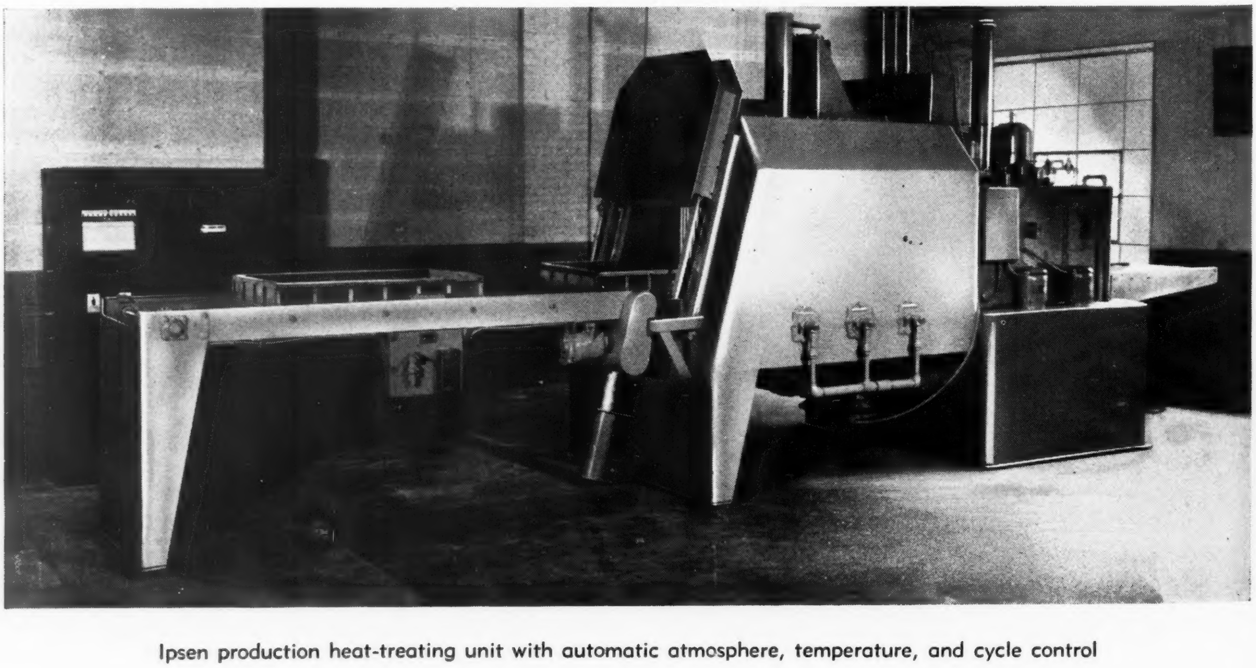
Viking Industries, 220 Montague St., Rockford, Ill., has brought out a simple, compact hydraulic attachment designed to provide complete mechanization of hand screw machines having ram type turrets. The complete unit consists of a 3/4-H.P. motor, two pumps, reservoir, fluid motor for operating turret pilot wheel shaft, control valves, and connections which can be installed in less than four hours.

With this equipment, adjustments can be made easily for any desired cycle of rapid traverse, feed, dwell, and quick return of the turret. Once set up, the operator simply starts the cycle with a hand-lever that may be conveniently located in any desired position. The cycle is stopped automatically after any series of operations. Settings for automatic individual cycles and feed rates can be made to suit different operations in six or any desired number of turret positions. The drive is designed for universal application on any standard make of hand screw machine turret, and requires no additional floor space.

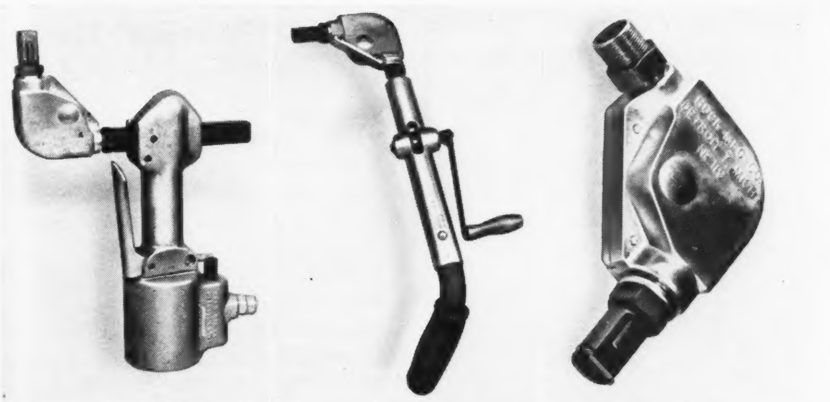
Ipsen Production Heat-Treating Unit

A medium-sized heat-treating unit designed for bright heat-treating, carburizing, martempering, carbon-nitriding, and annealing operations is announced by Ipsen Industries, Inc., 715 S. Main St., Rockford, Ill. This unit has a capacity for handling 500 pounds of material per hour. It is available for either electric or gas-fired operation and has automatic sealed atmosphere and temperature control. Work is transferred automatically from the heating through the quenching, or cooling chambers. A semi-automatic loader is provided as standard equipment.

Power-driven endless chains equipped with protruding lugs transfer the work trays from the heating chamber onto an elevator rack over the quench tank. When idle, the section of chain equipped with lugs remains out of the heat zone below the hearth. The unit is 5 feet 11 inches wide, 12 feet long without loaders, and 26 feet 8 inches long with loaders. The hearth is 30 inches wide, 48 inches deep, and 20 inches high. The maximum operating temperature is 1750 degrees F.



Ipsen production heat-treating unit with automatic atmosphere, temperature, and cycle control



(Left) Huck air riveting tool equipped with new angle adapter. (Center) Hand-operated blind riveter fitted with angle adapter. (Right) Angle adapter for blind riveting tools

Huck Angle Adapter for Blind Riveting Tools

The Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich., has announced an angle adapter which expands the scope of blind riveting to many additional assembly and maintenance applications. This angle adapter, when used in conjunction with either a Huck No. 94 hand riveting tool or a No. 93 air riveting tool, simplifies assembling operations on previously inaccessible deep channels, and other work difficult to reach.

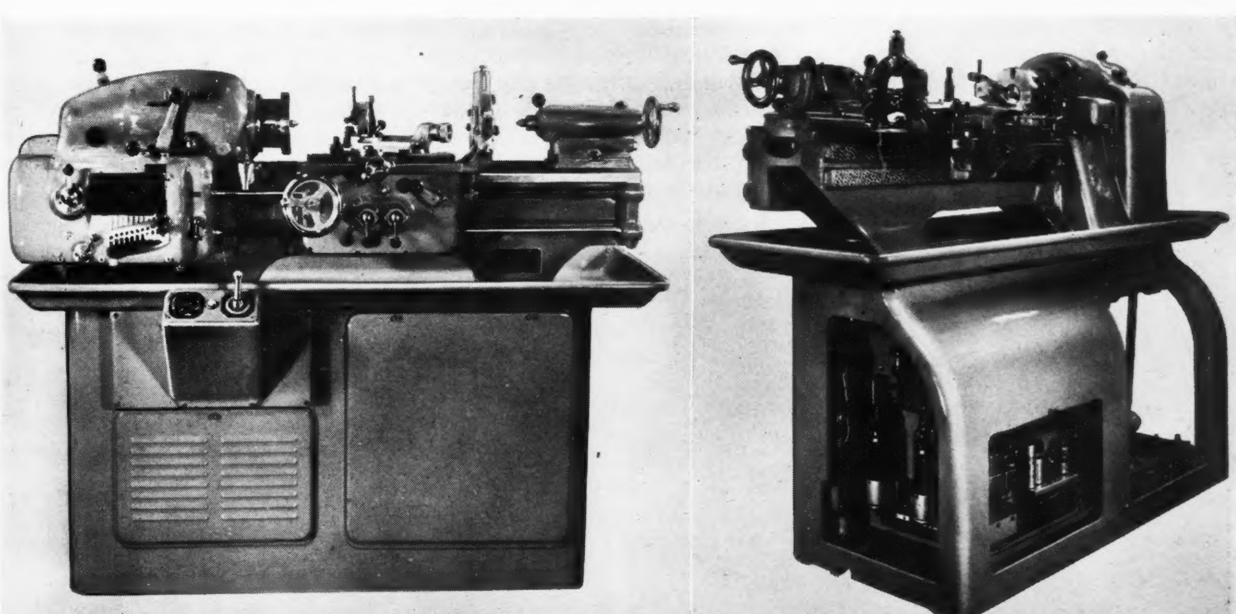
One person from one side of the work can now drive Huck 1/8-, 5/32-, and 3/16-inch diameter self-plugging or pull-through blind rivets in a clearance space of only 4 inches from nose of riveting tool to back face of angle adapter.

Stepless Variable-Speed Electronic Drive for Hendey Lathe

The Hendey Machine Co., Torrington, Conn., has placed on the market an infinitely variable-speed electronic drive for its 9- by 24-inch tool- and gage-maker's lathe. This Hendey unit is designed to fit into the base of the lathe as an optional control for the 3-H.P. direct-current, adjustable speed motor. The electronic drive contains only two 18-ampere heavy-duty electronic rectifier tubes in the power circuit, and one smaller rectifier tube in the control circuit. It provides stepless speed adjustment through a range of from 25 to 3000 R.P.M., by potentiometer control of both the field and armature windings of the motor. Extremely close speed control is said to be obtained even under changing load. Full torque is available at low speeds over the complete armature control range. A thermal overload relay protects the motor from sustained overloads.

The electronic unit requires approximately sixty seconds for heating, and power cannot be applied before the tubes are heated. A pilot on the control panel lights when the tubes are energized. The tubes will remain energized for immediate use during all ordinary stand-by periods. Dynamic breaking accomplishes a full stop from maximum speed in approximately one and one-half seconds. Starting, stopping, or reversing from pre-set speeds is accomplished smoothly and rapidly, even when set at 3000 R.P.M.

The control panel shown in the front view of the lathe in the accompanying illustration is conveniently located for the operator. The speed control knob and calibrated dial allow quick speed setting. The control handle is depressed when selecting forward or reverse motion, pulled to start the motor, and pushed to stop it. The pilot light is located between these two manual controls.



Front and rear views of Hendey tool- and gage-maker's lathe with new electronic drive

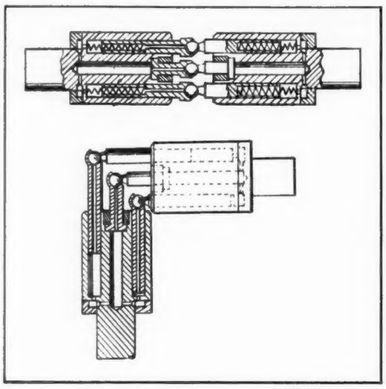
The Hendey electronic drive unit shown in the rear view of the lathe requires 220 or 440 volts, single-phase, 60-cycle current (550 volts, 60 cycles, optional). The direct-current 230-volt, 3-H.P. adjustable speed motor requires a line load of 4.2 K.V.A.

"Flexi-Versal" Universal Couplings for Power Transmitting Shafts

Universal joints or couplings designed to operate with constant velocity at high speed and full load at any angle within 190 degrees (included angle) and tested under load at more than 5000 R.P.M. are being introduced by the Spring Tool Co., 1102 N. Monroe, Peoria 3, Ill. The unit shown in the upper view will operate at any angle up to 40 degrees, while the one shown in the lower view will operate at any angle from 40 to 95 degrees.

Springs in the unit seen in the upper view act as a safeguard to keep the pins in proper alignment when crossing over the center. Springs are not necessary in the other design. The pins travel in an orbit and do not revolve, but as the universal joint revolves, the holes turn around the pins. The ball sockets do not turn but merely act as a hinge as the angularity of the drive is changed. The center pin only holds the driving and driven members together and is not needed in some cases.

These universal couplings may be built with from three to eight pins of any size depending on the application and torque load capacity. The unique design insures a film of lubricant to all moving parts. When filled with lubricant and properly housed, one lubrication servicing will last the life of the unit. As the members revolve, the pins move in and out with a reciprocal pumping action, and the lubricant is kept moving from one hole to another.



"Flexi-Versal" universal shaft couplings brought out by the Spring Tool Co.

"Portelvator" Tilt-Top Truck

A "Portelvator" tilt-top truck was built recently by the Hamilton Tool Co., 834 S. Ninth St., Hamilton, Ohio, for the specific purpose of handling 2000-pound broach-holders and positioning them for certain maintenance operations. This truck has a table top 24 by 96 inches, which rotates 360 degrees on a horizontal axis and can be locked in any desired position. The back-plate supports broach-holders and fixtures as the table tilts the work to the most convenient position.

The truck is provided with two wheels and four casters for easy maneuverability in restricted areas. Floor locks are located at each end of the truck to hold it in a fixed position.

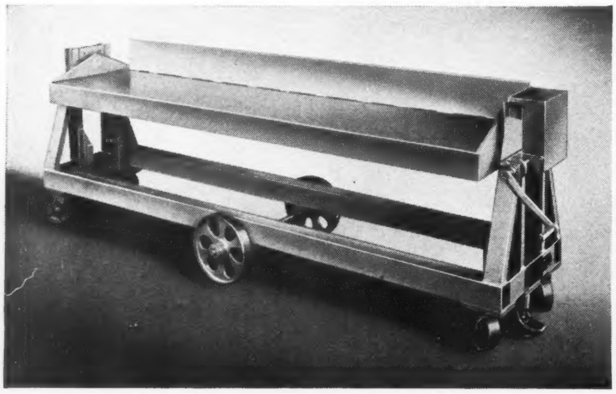
U. S. "Royalite" Hard-Shell Cup-Wheel

A new type of cup grinding wheel having a hard shell of tough resin-bonded abrasive has been announced by the Mechanical Goods Division, United States Rubber Co., Rockefeller Center, New York 20, N. Y. The hard shell is 3/16 inch thick and resists "mushrooming" or rounding of the cutting edge so that wear occurs evenly across the entire face of the wheel. It is particularly useful for accurate grinding of hard-to-reach corners and complicated shapes. The over-all diameter of the wheel is tapered from 6 to 4 3/4 inches and the thickness is 2 inches.

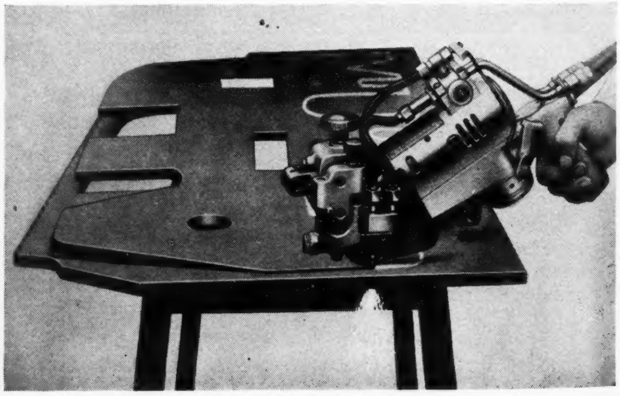
Pullmax Flame Cutter

A portable, hand-operated flame cutting machine which weighs only 19 pounds has been announced by the American Pullmax Co., Inc., 2455 N. Sheffield Ave., Chicago 14, Ill. This all-purpose flame cutter, designated "Cadet," was designed to facilitate operation and will cut plate from 5/64 inch to 2 1/4 inches in thickness. It will do straight and I-beam cutting, circle cutting to a radius of 1 inch, and bevel cutting. The torch can be set at any angle for bevel cutting, graduations in 5-degree increments being inscribed on the torch-holder body.

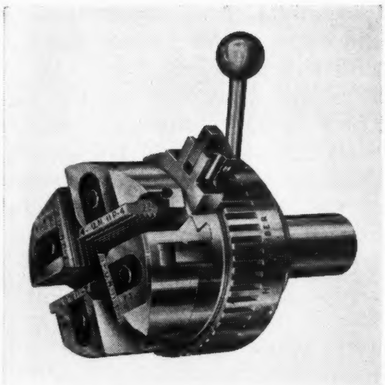
Tabular data attached to the machine gives the proper cutting speed, oxygen pressure, and type of torch tips to use for any cutting job. The correct distance between the tip and work surface is also given in the table. All parts of the flame cutter are easily accessible and interchangeable.



Tilt-top truck for handling heavy broach-holders



Pullmax portable hand-operated flame cutter



Stationary type self-opening die-head brought out by the Landis Machine Co.

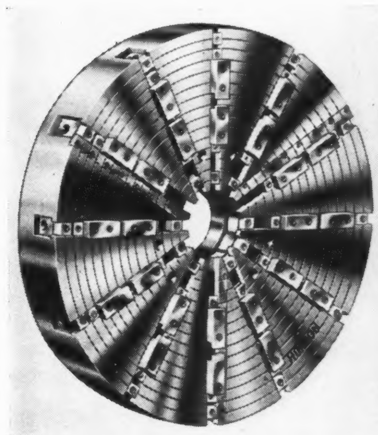
Landmatic Self-Opening Die-Head

A stationary, self-opening die-head with a capacity range from No. 4 threads to 5/8 inch diameter, designed for application to turret lathes, hand screw machines, and automatic screw machines, has been brought out by the Landis Machine Co., Waynesboro, Pa. This die-head, known as the 5 HH, has a small number of working parts. The parts are made of a special alloy steel, and are hardened and precision ground to assure maximum accuracy and long life.

A new size adjusting mechanism provides a positive locking action. It consists of a pivoted latch held in engagement with notches on the adjusting ring by spring tension. To adjust the head, the latch is depressed and the adjusting ring is rotated manually the required amount. The notches are so located on the adjusting ring that a movement of one notch provides a corresponding movement of 0.001 inch on the pitch diameter of the workpiece.

Opening action is obtained by interrupting the forward travel of the turret-slide, or carriage, or if the "pull off" opening action is not desired, the head may be opened by hand. Closing of the die-head is achieved by hand. Chaser holders operate in dovetail slots in the head body. They have an unusually wide bearing surface consisting of the combined areas of the dovetail section of the holder body, and thus provide maximum strength, rigidity, and accurate support for the chasers.

Left-hand chaser holders are required for cutting left-hand threads. However, no other changes are necessary for left-hand threading, and the same chasers may be employed for both right- and left-hand work by merely grinding the proper cutting angles at both ends of the chasers.



"Pinch type" twelve-jaw chuck for holding jet-engine parts recently developed by E. Horton & Son Co.

Horton "Pinch Type" Chuck for Jet-Engine Parts

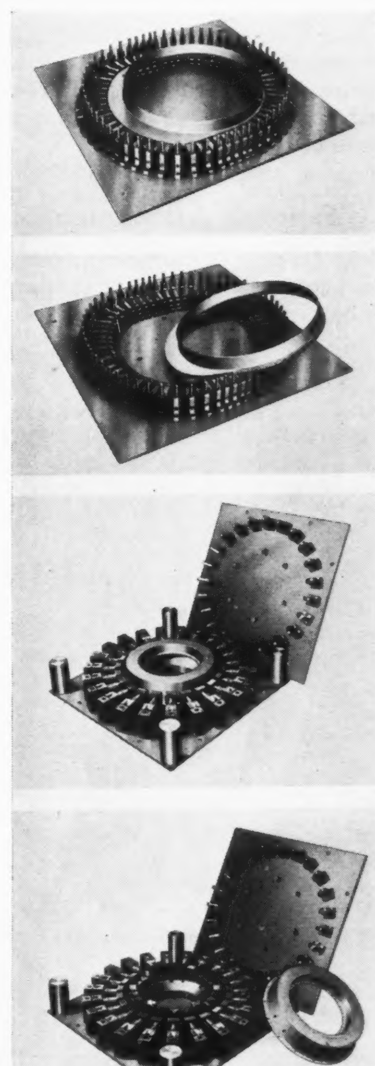
The E. Horton & Son Co., Windsor Locks, Conn., has brought out a chuck for holding jet-engine parts for first and second machining operations. This chuck, designated the "J-Type," has twelve jaws, three of which are of universal design, while nine are independently adjustable.

As the jaws of this "pinch type" chuck are moved inward, the first jaw to come in contact with the work stops automatically, while the remaining mating jaws continue to travel until a firm grip on the work has been established. This quick locating feature is advantageous in machining operations on stress relieved or distorted parts, because the three universal jaws "float" and can be run in quickly by hand to center the piece, while the nine independent jaws move up to grip the part.

The chuck is available in standard sizes up to 46 inches. It can be furnished with either a semi-steel or aluminum body. The top work-gripping jaws can be furnished soft or hard to specification. This "pinch type" chuck is the second in a series of "J-Type" chucks developed to meet the needs of jet-engine manufacturers.

Wales Hole-Punching Units

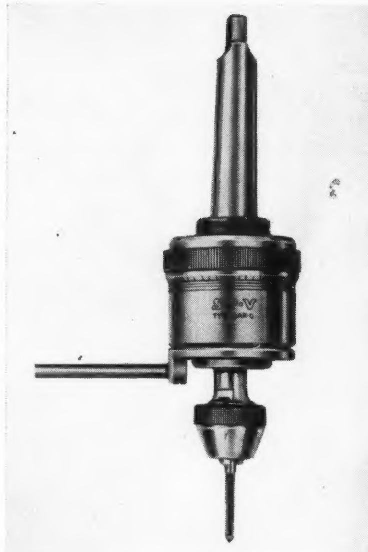
A new series of Type "H" hole-punching units has been announced by the Wales-Strippit Corporation, 345 Payne Ave., North Tonawanda, N. Y. These units are designed for punching holes in flanges, angles, container sides, and similarly shaped and formed work. Punching holes in the side of the work instead of on top of the flat surface is made possible by designing these units



(Top) Template set-up of Wales Type "H" units for punching holes up to 1/4 inch in diameter in aircraft-engine part. (Second from top) View of above set-up with part removed to show holes punched around the side and flange. (Second from bottom) Template set-up for punching holes up to 5/8 inch in diameter in another aircraft-engine part. (Bottom) Above set-up with part removed. Note hold-downs on template in background

so that the punches move back and forth horizontally rather than up and down.

Each unit is independent and self-contained. The same group of units can be used on press brake rails and on templates in stamping presses and press brakes. Punches and dies are easily removable from the unit for sharpening and replacing. In cases of replacements, an entire unit may be removed and replaced quickly in the set-up without disturbing the other parts of the set-up. With a few extra units, it is possible to interchange them rather than stop a production run to replace or sharpen a punch or a die, thus permitting punches and dies to be sharpened at a more convenient time.

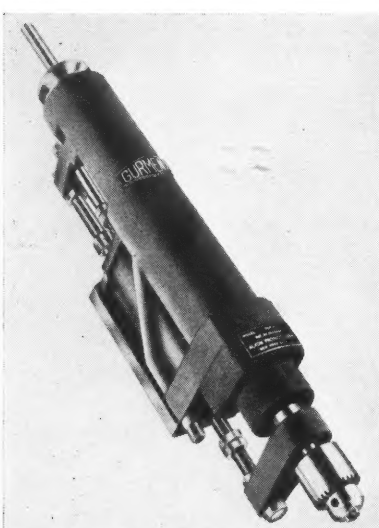


Tapping attachment marketed by the Eric S. Johnson Co.

Tapping Attachment

A tapping attachment developed to enable tapping operations to be performed without any risk of damaging work or equipment has been announced by the Eric S. Johnson Co., 230 E. Ohio St., Chicago 11, Ill. The dimensions and forms of the threads produced with this attachment are said to be solely dependent on the tap. There is no possibility of double threading pre-tapped holes. The finishing tap is allowed to rotate at full speed, and on being fed into the pre-tapped hole, automatically picks up the thread.

The mounting of the axially sliding body in two needle bearings reduces axial stress and eliminates, as far as possible, friction tending to influence the free axial motion. The necessary torque, which is conveniently adjusted on a graduated scale, is transmitted through a mechanical locking device that is not affected by variations in speed, oil, or heat. The patented reversing device permits a rapid action through the medium of a radial bearing. When the tap reaches the bottom of a blind hole, the attachment reverses as soon as the drill spindle starts to back up.

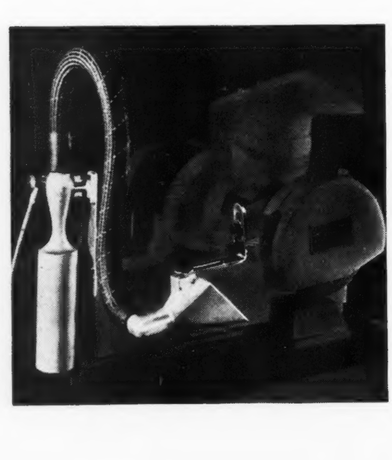


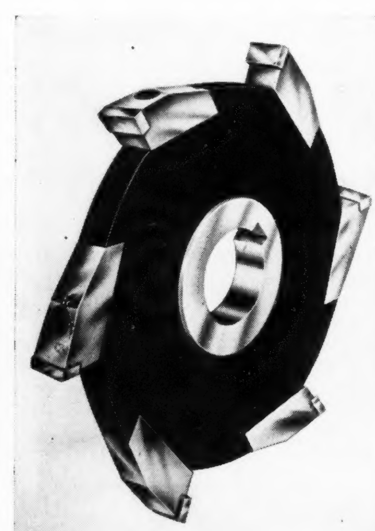
Air-Powered Drill Unit

Gurmendi air drill unit developed for universal application in set-up and power choice, announced by Alkon Products Corporation, 698 E. 142nd St., New York 54, N. Y. This unit contains a unique hydraulic monitor designed to provide quick approach to work, positive adjustable feed rate through work with no danger of break-through, and rapid return. Positive stop adjustments are provided for both forward and return strokes. The full 2-inch stroke has a controlled feed of 1 1/4 inches. The spindle is equipped with 1/4-inch capacity Jacobs chuck. Compact design allows a set-up of two or more drill units as close as two inches between centers. Many units can be powered by one motor. The speed of each unit can be easily adjusted up to a maximum of 12,000 R.P.M.

Individual Vulcanaire Dust Collecting Unit

Compact dust removal unit with no moving parts, operated from regular shop air supply. These units are easily installed in a few minutes and are designed for use where centrally located dust collecting systems are not feasible. This unit is available in two sizes: a 200 Series with capacity of 24 cubic inches for grinding wheels 2 inches or less in diameter, and a 700 Series with capacity of 56 cubic inches for grinding wheels 7 inches or less in diameter. Product of the Vulcan Tool Co., 730 Lorain Ave., Dayton 10, Ohio.



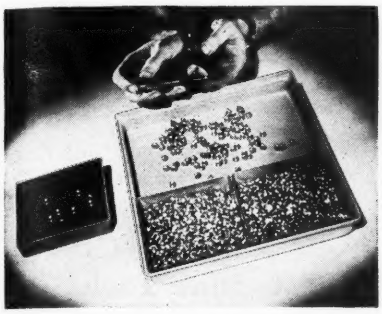


Carbide-Tipped Milling Cutter

Patented carbide-tipped milling cutter developed by Millet Division, Kraus Design, Inc., 39 Flint St., Rochester 8, N. Y. This new cutter, combines the advantages of solid and inserted blade types. Interchangeable blades are seated on periphery of cutter body with tail end seated against an abutment in the body. Cutting forces are thus transmitted to the body through this abutment. Heat-treated body bound screws accurately locate the blades against the body abutment through a conical seat. Available with blades for straight slotting, alternate blade slot-

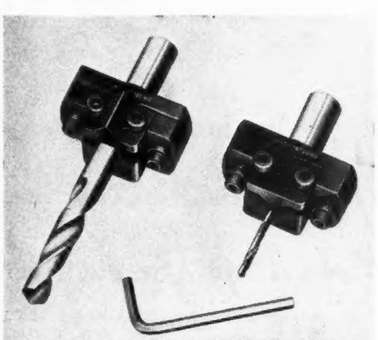
(This section continued on page 245)

ting, or half-side milling. Variations in rake and shear angles required for cutting different materials are accomplished by a quick change of blades. Standard stock sizes of plain and side milling cutters are now available in widths of 1/2 and 3/4 inch which range from 3 to 8 inches in diameter.



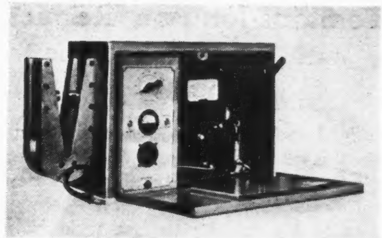
Inspection Trays for Small Parts

Set of inspection trays for small parts, consisting of one "pick-up tray" 11 by 9 3/4 by 1 1/4 inches deep, and three "insert trays" each 4 1/2 by 4 1/4 by 1 inch deep, all being formed of sheet Boltaron plastic material, which is light in weight, non chipping, non-contaminating, and resistant to oils, alkalies and solvents. The trays are easy to clean, and withstand rough usage and variable temperatures. These sets will be available in a variety of standard colors for use in plants producing precision parts such as aircraft rivets, machine screws, etc. Announced by Durable Formed Products, Inc., 329 Canal St., New York City.



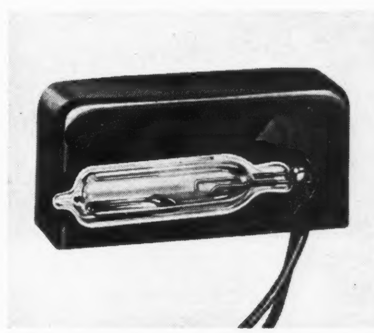
Brookfield Tool-Holder

Tool-holder with adjustable V-jaw that will hold drills, counterbores, reamers, and other tools of any diameter from 1/64 to 1/2 inch without using bushings or other accessories. Adapted for use on turret lathes, drilling, cutting, and reaming machines. Made in stock shank sizes of 5/8 and 3/4 inch. The entire unit is made of hardened steel, stress relieved, and has precision ground surfaces to insure holding run-out to less than 0.0001 inch per inch. Product of Brookfield, Inc., 755 Boylston St., Boston 16, Mass.



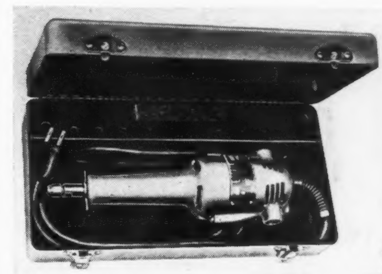
Surface Resistance Indicator

Device for measuring surface electrical resistance, directly in microhms, as a criterion of the effectiveness of a cleaning process. Designed primarily for measuring the resistance of aluminum, but other materials with low surface resistance may also be measured. Announced by Weltronic Co., 19500 W. Eight Mile Road, Detroit 19, Mich.



New Mercury Switch

Mercury switch embedded in plastic "potting" compounds for added protection, announced by Micro Switch, Freeport, Ill., Division of Minneapolis-Honeywell Regulator Co. This switch is 2 1/2 inches long, 3/4 inch wide, and 1 1/8 inch high. It has an electrical rating of 2 amperes 115 volts alternating current, or 1 ampere 115 volts direct current. Contact arrangement is single-pole, normally open.

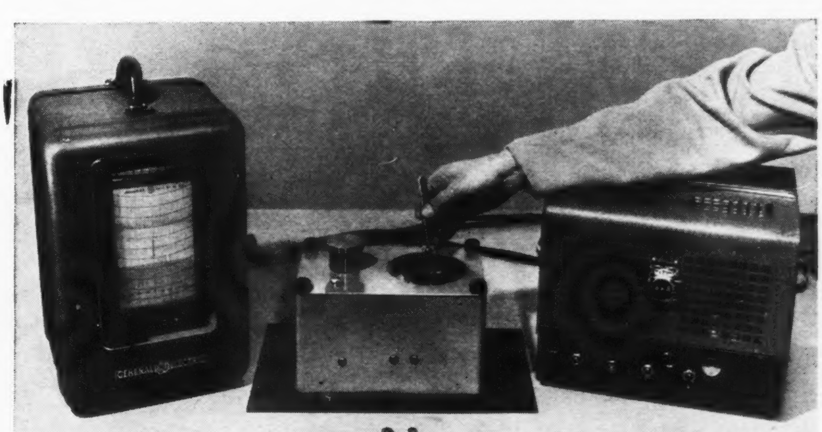


Skilsaw Hand Grinder

One of three hand grinders for use with mounted wheels and points just announced by Skilsaw, Inc., 5033 Elston Ave., Chicago 30, Ill. These new grinders are adapted for use in tool and die departments and pattern shops as well as by designers and model-makers, or wherever a lightweight, powerful utility grinder is required. Model 137 is equipped with a 5/32-inch capacity geared chuck and has a speed of 20,000 R.P.M. Model 146 also has a speed of 20,000 R.P.M. but comes with 1/8-inch and 1/4-inch collet chucks. Model 148 has an ultra high speed of 36,000 R.P.M. and 1/8-inch and 1/4-inch collet chucks. Models 137 and 146 are designed for use with shank accessories of 1 3/4 inch and smaller diameters. Model 148 will take accessories with shanks 1 inch in diameter or smaller.

G-E Ball-Bearing Torque Tester

Torque tester designed to serve as a quality control check of ball bearings to be used in small instruments. It is adapted for use in both production line and laboratory work. Basically, the bearing torque is determined by measuring the current drawn by a torque motor in counterbalancing the bearing race torque, as indicated by an electromagnetic pick-up. This saves hours of assembly and disassembly work by making possible the detection of dirty or defective bearings before their installation in an instrument. Announced by Special Products Sales Section, General Electric Co., Schenectady 5, N. Y.

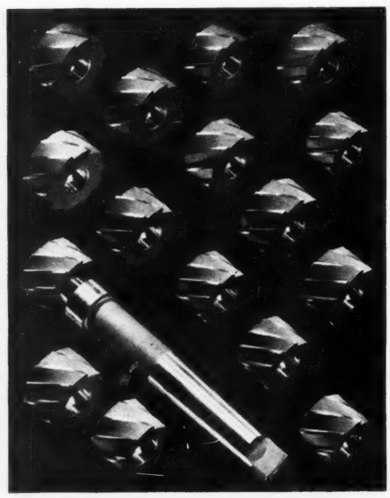


Waterproof Snap-Action Micro Switch

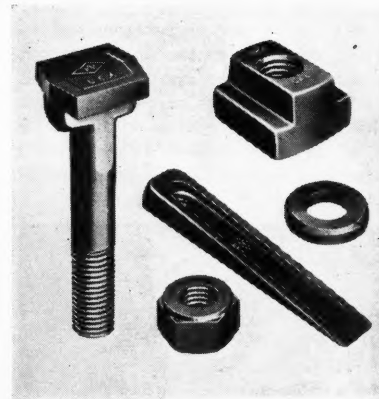
Waterproof, snap switch incorporating waterproof terminal leads and a hermetically sealed contact chamber, just announced by Micro Switch, Freeport, Ill., Division of Minneapolis-Honeywell Regulator Co. The electrical rating is as follows: 10 amperes inductive load, or 25 amperes resistive load, 28 volts direct current; 1 ampere inductive or resistive load, 125 volts alternating current. This switch can be had with single-pole, single-throw, or double-throw contact arrangements. The operating force is 16 ounces $\pm$ 6 ounces; minimum release force is 4 ounces; maximum pre-travel is 0.065 inch; maximum differential travel is 0.020 inch; minimum overtravel is 0.010 inch; and minimum contact break distance is 0.036 inch.

Tomkins-Johnson Reamer with Interchangeable Heads

Line of reamers so designed that one shank is quickly and easily interchanged with a wide range of heads. This new feature is claimed to cut replacement costs of the reamer to less than half. The reamers are available in spiral or straight flute types. The quick-change feature enables the machinist to change



heads easily when reaming different metals and thus obtain maximum performance. Announced by Tomkins-Johnson Co., Jackson, Mich.

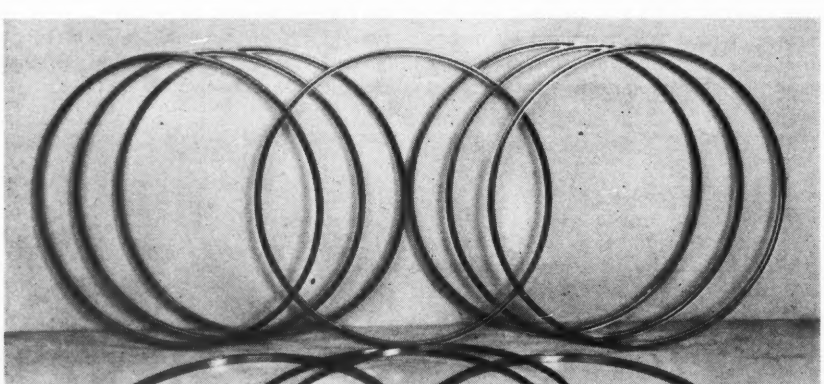


Set-Up Accessories for Machine Tools

T-slot bolts, nuts and flat washers, T-slot nuts, and set-up wedges recently added to the line of strap clamps in the line of set-up accessories made by J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N. Y. These accessories are used for setting up work on planers, shapers, milling machines, etc. All are made to withstand severe machine shop use. Available in six T-slot sizes ranging from 3/8 to 1 inch in a wide range of lengths.

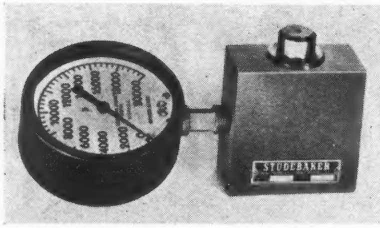
Thin Ball Bearings of Large Diameter

Bearings claimed to be the world's thinnest, made with the precision of fine watch parts by the Kaydon Engineering Corporation, Muskegon, Mich. These ball bearings have an outside diameter of 17.625 inches and an inside diameter of 16.875 inches. The bearings weigh only 2 pounds and have a cross-section thickness of only 0.375 inch. To illustrate the extreme thinness of these bearings, it is pointed out that, proportionately, a wedding ring with a comparable 17.625-inch outside diameter would be about four times as thick as the actual 0.375-inch section of these bearings.



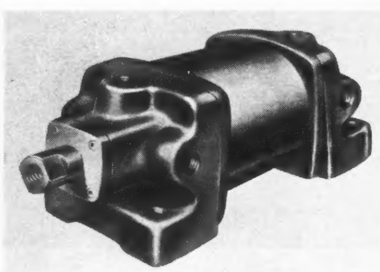
Dremel Moto-Screwdriver

One of a line of "motor-in-hand" electric screwdrivers brought out by the Dremel Mfg. Co., Racine, Wis. Light in weight, small in size, and designed to be used at right angles to the work. The smaller Model SD-1 drives free-running screws or nuts from Nos. 0 to 4 inclusive; the larger Model SD-2 is for sizes from Nos. 4 to 8, inclusive. The smaller model weighs but 12 ounces, is 4 3/4 inches long, with a bit speed of 1200 to 1400 R.P.M. The larger model weighs 18 ounces, is 6 1/2 inches long, with a bit speed of 1400 to 1600 R.P.M. These screwdrivers can also be used for unscrewing by merely inserting a bit into the top chuck and turning the machine over in the hand. Both models have a slip clutch to assure even screw tension.



Tester for Determining Pressure of Ram on Work

Pressure tester developed to directly and accurately indicate the actual pressure in pounds exerted by press ram on work. It is especially useful in insuring quality control where accurate ram pressures must be maintained. Can be used either vertically or horizontally. Made in three sizes having maximum capacities of 10,000, 50,000, and 100,000 pounds. Higher capacities are available on order. Product of Studebaker Machine Co., 1190 S. 9th Ave., Maywood, Ill.



High- and Low-Pressure Hydraulic Air Cylinders

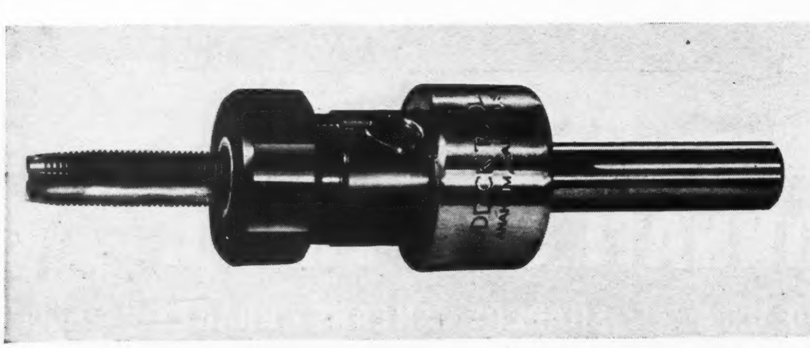
One of a complete line of high- and low-pressure hydraulic and air cylinders announced by the Excel Machine & Mill Supply Co., Williamsville, N. Y. All cylinders in this new line have improved self-adjusting rod packing and leak-proof adjustable cushions. They are available in all commonly used bore sizes from 1 1/2 to 12 inches in diameter and strokes up to 48 inches. High-pressure cylinders are designed for operation at 200 pounds per square inch. Low-pressure cylinders are designed for service up to 800 pounds per square inch.

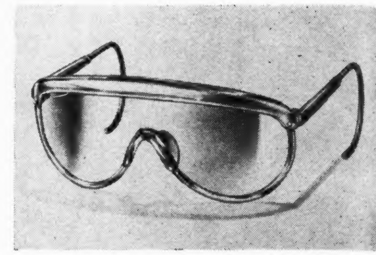
Errington Cone Drive Tapping Chuck

Small size cone drive tapping chuck brought out by the Errington Mechanical Laboratory, Inc., Staten Island 4, N. Y. This chuck is designed to operate at high speeds. It has an oil-resistant plastic chuck cone, and is provided with needle bearings at the top and bottom of main spindle. Available with collet chuck or Jacobs rubber-flex tap chuck in three sizes which cover a range of tap sizes from No. 0 to 1/2 inch. The chuck is very sensitive in operation and has minimum play between drive and reverse.

Self-Releasing Tap-Holder

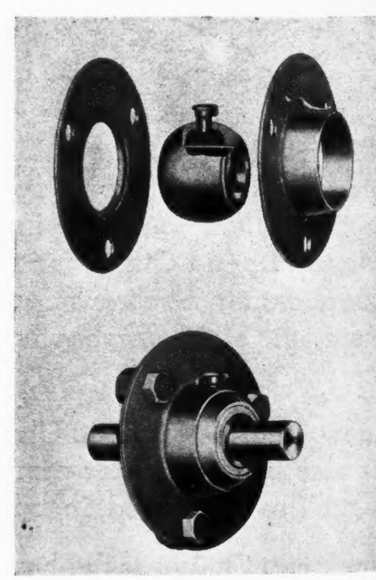
Self-releasing tap-holder recently developed by the Roddick Tool Co., Anaheim, Calif. This tap-holder can be used for either right- or left-hand threading. Steel balls are incorporated in the mechanism which provide for accurate control of the thread depth. Power feed can be used, providing the feed does not exceed the threading rate of tool. Taps can be changed in a few seconds, the Jacobs rubber-flex collet at the front of the holder taking No. 10 to 1/2-inch taps. Available with 5/8- and 3/4-inch shanks.





Safety Goggles and One-Piece Bi-Colored Lens

Safety goggle, featuring a transparent plastic frame which provides a greater field of vision, announced by American Optical Co., Southbridge, Mass. This new goggle can be worn directly over the eyes or over spectacles. It is particularly useful for protection against foreign particles on machine and hand tool work, laboratory work, spot-welding, light grinding, light chipping, and light riveting. Another new product of this company is a one-piece bi-colored lens, designed specifically for workers exposed to intense visible light, ultra-violet and infra-red radiations. This lens is hardened for utmost impact protection, following the company's special fusing process, and has the strength of a single lens. Available in different shades and in both flat and curved varieties.



Randall Self-Aligning Bearing for Sheet Metal Fabricated Units

Views of disassembled and assembled low-cost, flange sleeve bearing unit specially designed for light shaft duty and power take-off applications on all types of sheet metal fabricated units. The flange mounting is made of 16-gage steel, press shaped to conform with the spherical shape of the ball assembly. The machined cast-iron hol-

● *Photo—Courtesy Aerojet—Division of The General Tire & Rubber Co.*

Working on rocket motors at Aerojet—Division of The General Tire & Rubber Company, this versatile 4′ 9″ column Cincinnati Bickford Super Service Radial is economically drilling and tapping in type 347 stainless steel.

Class 3 fit is required on the tapping operations of these ½″ x 20″ and 7⁄16″ x 24″ holes.

In this unusual installation a 12-foot pit permits processing of large work in vertical position, while another piece is set up on large V-block fixtures on plain box table.

The centralized controls clear view Bickford Head, and wide selection of speeds and feeds all bring ease and economy on this job.

Write for Booklet R-21-B.

CINCINNATI BICKFORD

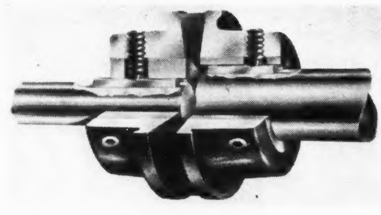
SUPER SERVICE CB

RADIAL AND UPRIGHT DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO.

Cincinnati 9, Ohio U.S.A.

low ball forms an oil reservoir when the bushing is pressed into place. Oil is fed to the bearing surface by the capillary action of the sintered or graphited bushing, whichever is required. Heat increases the capillary action, thus providing a self-lubricating feature. The bearing assembly is 3 1/2 inches in diameter by 1 1/4 inches long, and is available with sintered bushing in five shaft sizes from 1/2 inch to 1 inch and with graphited bushing in three sizes of 1/2, 5/8, and 3/4 inch. Product of Randall Graphite Bearings, Inc., 1011 S. Greenlawn Ave., Lima, Ohio.



Maurey Flexible Couplings

Small, compact, cast-iron, bushing type flexible coupling made in sizes for applications up to 10 H.P. Each coupling has two cast-iron hubs joined by a bonded rubber section perfected by the Goodyear Tire & Rubber Co. for this product, which has just been announced by the New Products Division, Maurey Mfg. Corporation, Chicago 16, Ill. The couplings will be available in three bore sizes for use with the three standard Maurey types of interchangeable bushings. The smallest coupling has a 1-inch bore and affords 21 possible bore combinations. With the larger 1 11/16-inch and 2 9/16-inch bore flexible couplings there are 136 and 210 possible bore combinations, respectively.

Inspection of Welds by X-Raying Hot Metal Saves Time on Big Jobs

A process of taking X-ray photographs of large pipes, valves, and similar units at temperatures as high as 1200 degrees F.—the McElroy-McNutt "hot radiography" process—has been applied by Sam Tour & Co., Inc., New York City, with considerable success to the inspection of partially completed welds on hot sections of pipe to detect possible welding defects. Because "hot radiography" can be accomplished at elevated temperatures, it eliminates several time-consuming steps necessary for the usual radiographic inspection techniques.

Radiography involves taking a picture of a material by placing a sensitized film on one side of the material and a source of X-rays or gamma rays at the opposite side. Ordinarily, before the film can be placed on the weld, the pipe section must be cooled down to about 100 degrees F. With certain types of alloys, this cooling must be preceded by post-heating the weld to relieve internal stresses. Because of the lengthy cooling period involved, the usual practice has been to complete the weld before inspecting it. "Hot radiography," however, can be used to check a hot pipe, thereby making it practical to interrupt the welding operation to inspect the weld root where most flaws occur.

This technique, therefore, saves the many man-hours of heating and controlled cooling that were formerly required before the weld could be inspected. If defects are found, it is necessary to chip away only a partially completed weld, rather than a finished weld. This new technique can also be used for radiography of other forms of hot metallic materials.

Inspecting partially completed weld by the McElroy-McNutt radiographic process while the metal is hot

Radioactive Cutting Tools Predetermine Tool Life

The volume of metal removed before a tool needs sharpening—the tool life—can now be rapidly predetermined. The new laboratory technique is currently in the process of refinement by research engineers at the Cincinnati Milling Machine Co. It consists of machining with a tool which has been rendered radioactive by neutron irradiation in a nuclear reactor; then, by means of a Geiger counter, measuring the radioactivity of all the chips formed during a few seconds of cutting.

The chips will be radioactive because of the particles abraded from the tool. Better than 90 per cent of the tool material worn away during cutting clings to the chips, so the amount of radioactivity of the chips is a fairly close approximation of the amount of tool wear. Since the rate of tool wear is known to be essentially constant throughout the service of the tool, it is possible to compute the tool life after just a few seconds of machining time.

The application of radioisotopes to this testing appears to hold considerable promise for greatly speeding up and simplifying the normally expensive and slow process of obtaining essential data on machinability.

Between Grinds

By E. S. Salichs

For He's a Jolly Good Whale

Sperm whales are much sought after these days, not perhaps socially speaking, but their popularity is related to the demand for sperm oil. Seems sperm oil is essential for such mechanisms as automatic shifts for automobiles, since it does not stiffen up when cold or thin out dangerously when heated. Better move along, Moby.

Pop Takes His Family to "Pops" Concerts

Down East in Worcester, Mass., four industries are sponsoring a series of free, outdoor popular concerts over the summer. The organizers are Heald Machine Co., Norton Co., Wyman-Gordon Co., and Morgan Construction Co.

Super Split Second

Now an electronic stop-watch divides the second into 8,000,000 parts. This is the counter-chronograph developed by the Potter Instrument Co., Inc., Great Neck, N. Y. What a relief—we were getting a bit jammed up for time.

Ore Else

"Induced caving" is an economical mining technique adapted by the International Nickel Co. of Canada, Ltd., to recover nickel ore lower in grade than has previously been worked. All one does is slice a wedge of ore out of the earth—say 1,500,000 tons—gravity does the rest. If the slice of ore is tough (and what caver or carver hasn't come across this situation), some judiciously applied explosives do the trick.

Sticking with It

Here is how one large English concern expedites mail. Reginald Smythe, in the engineering department, writes us a letter; pastes the left-hand side of a red perforated sticker on his letter. Upon answering it, we tear off the right-hand unstuck part of the sticker, which reads Engineering (assuming that Reggie has played fair and gummed it only halfway), and slap it on our letter. Received by the concern, it wings back to Reggie in Engineering without detouring to some Smythe's desk in another department.

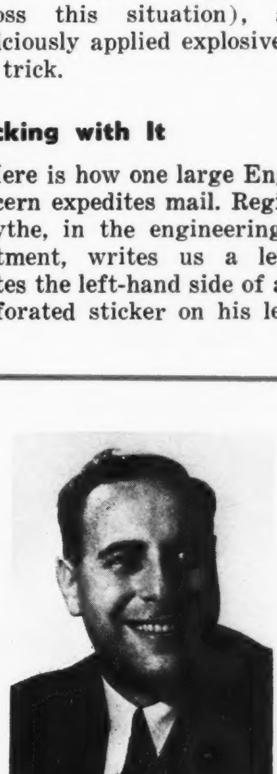
Stacking the Stakes

Were you "making with" the poker chips, we are sure you would not be considering why they stack so perfectly. In this objective moment, however, you might be interested—they are cut off in thin wafers with abrasive cut-off wheels and then centerless ground to size.

Seen on a Washington, D. C., Desk —

"If you can keep your head when everyone else is blowing his top—you just don't grasp the situation."

MACHINERY Introduces — EDGAR ALTHOLZ, our new and pleasant associate editor, is a native Long Islander who, after dipping deep into Cayuga's waters for knowledge (which is a "classy" way of saying that he was graduated from Cornell University), proceeded to gather a thoroughly practical knowledge of machine shops. Journeyman machinist, apprentice supervisor, and foreman were among the early titles he acquired. During World War II, Mr. Altholz served his stint in the army as an instructor at an ordnance depot, which led to his serious interest in vocational education. In 1949, he joined the faculty of the International Correspondence Schools, Scranton, Pa., as a technical writer and editor. In that capacity, he wrote a series of original texts on drilling, broaching, shaping, planing, milling, and turret lathe work. Later, as director of the I.C.S. School of Shop Practice, Mr. Altholz supervised the work of students in numerous machine shop courses. The wheel turning, he became associated with MACHINERY to propound the latest data on metal-working practice for the benefit of our readers. And, incidentally, he is back on Long Island. A week-end golfer and trout fisherman, we haven't yet worked on his confession of smallest score and biggest fish, or vice versa, but some humid midsummer day shall get him to tell all.



Edgar Altholz

News OF THE INDUSTRY

California, Colorado, and Oregon

KURT ORBAN CO., INC., New York City, distributor of German-built machine tools, has opened an office at 8687 Millrose Ave., West Hollywood, Calif. Dr. F. W. STRASMANN will be in charge of the new office. He was formerly assigned to the company's Cleveland office.

LEIGH H. NORGREN, assistant to the factory manager at the C. A. Norgren Co., Englewood, Colo., has been promoted to the position of plant superintendent.

J. E. HASELTINE & CO. has been appointed distributor for the GORHAM TOOL CO., Detroit, Mich., in the Northwest. The distributor maintains offices at 155 S.W. Second Ave., Portland, Ore., and at 510 First Ave., Seattle, Wash.

Illinois

HAMILTON MIGEL, second vice-president and eastern manager of the Magnaflux Corporation, Chicago, Ill., has been named to a newly created position, that of second vice-president in charge of engineering. Roy O. Schiebel, Jr., currently middle west manager at Chicago, Ill., will become eastern manager with headquarters in New York City, while KERMIT A. SKEIE is assuming Mr. Schiebel's former duties in Chicago.

HAROLD J. SMITH was recently appointed manager of the Chicago, Ill., district of the National Acme Co., Cleveland, Ohio. He succeeds R. J. PRESTON, who died on May 14 after forty-two years of service with the company. Mr. Smith had been a sales engineer in the Chicago district at the time of his appointment.

HARVEY ALUMINUM DIVISION OF HARVEY MACHINE CO., INC., Torrance, Calif., has announced the opening of a Chicago branch, located in the Pure Oil Bldg., 35 E. Wacker Drive, Chicago, Ill. ART LAKIN has been appointed managing sales engineer of the branch.

THE VASCALOY-RAMET CORPORATION, Waukegan, Ill., has begun the construction of a new building in Waukegan in order to expand its facilities for producing carbide cutting tools, wire and tube drawing dies, etc.

KINGSBURY MACHINE TOOL CORPORATION, Keene, N. H., has appointed the FOUR STATES MACHINERY CO., Chicago, Ill., distributor in the Chicago, Ill., and Milwaukee, Wis., areas.

EDGAR J. HAAS has been appointed field representative for the Chicago Wheel & Mfg. Co., Chicago, Ill., in Louisiana, Mississippi, Arkansas, and Tennessee.

DOALL CO., Des Plaines, Ill., has opened a plant in Toronto, Canada, to be devoted exclusively to the manufacture of saw bands, both for Canadian and export markets.

V. A. HEDLUND has been appointed special service engineer in the electronics field for Shakeproof, Inc., a Division of Illinois Tool Works, Chicago, Ill.

REED-PRENTICE CORPORATION, Worcester, Mass., announces that its Chicago sales office has moved to 4401 N. Elston Ave., Chicago 18, Ill.

WILLIAM L. SHANK, who joined the Ingersoll Milling Machine Co., Rockford, Ill., a year ago as assistant to the president, has now been elected a vice-president of the company.

William L. Shank, who has been elected a vice-president of the Ingersoll Milling Machine Co.

Indiana and Missouri

FRED A. COLLINGE, president and general manager of the G. M. Diehl Machine Works, Inc., Wabash, Ind., manufacturer of woodworking machery since 1938, has been made chairman of the board. JOHN A. COLLINGE has been elected president and general manager. He has been associated with the company for twelve years.

FRANK B. POWERS has joined P. R. Mallory & Co., Inc., Indianapolis, Ind., as vice-president in charge of manufacturing.

NOOTER CORPORATION, St. Louis, Mo., fabricator of steel and alloy plate processing equipment is transferring its Metallizing Division to a new company which will be known as the ST. LOUIS METALLIZING CO., located at 625 S. Sarah St., St. Louis, Mo.

GEORGE W. BROWN has been appointed executive engineer of the Wagner Electric Corporation, St. Louis, Mo.

Massachusetts and Connecticut

NORTON CO., Worcester, Mass., announces the following changes in personnel: H. PAUL OTTO, who was supervisor of the Worcester sales office, Grinding Machine Division, becomes district manager at Hartford, Conn., replacing CARL W. ATWOOD, who is retiring after thirty-two years of service with the company; JOHN D. PUTNAM assumes the position vacated by Mr. Otto; THOMAS M. THORNTON, formerly field engineer of the Abrasive Division in Detroit, Mich., becomes district sales engineer with headquarters there; ALLEN C. MOORE joins that division, having completed the company's sales training course; ROBERT CUSHMAN moves to Los Angeles, Calif., being made Pacific Coast district manager, to replace LUCIEN GAY, present district manager who is retiring; DONALD F. JONES, abrasive engineer, takes over Mr. Cushman's central New York area; KENNETH F. EBBESON, formerly grinding engineer, becomes field engineer in the northeastern district; HARRY G. BRUSTLIN, abrasive engineer in the Rocky Mountain area, is transferring to the Pacific Coast district, while GORDON S. BRANDES assumes his territory.

(Left) B. Walter Swanson, new factory manager of the Hanson-Whitney Co.; (Right) E. P. Cody, general sales manager, and in addition, office manager of the company

B. WALTER SWANSON has been made factory manager for the Hanson-Whitney Co., Hartford, Conn. Mr. Swanson previously served as New England manager of sales and service. E. P. Cody, general sales manager of the company, has been appointed office manager in addition to his present duties.

BAY STATE ABRASIVE PRODUCTS Co., Westboro, Mass., announces the promotion of the following men from the sales engineering staff to positions as abrasive engineers: JOHN R. BOUDREAU, Dallas, Tex.; ROBERT A. GREEN, Detroit, Mich.; RUSSELL L. KING, Chicago, Ill., and JOHN R. MELE, Toledo, Ohio.

GEORGE B. CLAY has been promoted from superintendent to sales manager of the machine division of Hobbs Mfg. Co., Worcester, Mass. Philip A. Blair has been named assistant sales manager of the fastener division.

RAYMOND T. FENN has been named chief engineer for the Sterling Engineering Corporation, Winsted, Conn.

Michigan

JOSEPH C. MORRISON has become manager of the Edmore, Mich., plant of the Carboloy Department of General Electric Co., Detroit, Mich. Mr. Morrison joined the General Electric Co. in 1941, and most recently was superintendent of the Alnico Division. Other appointments announced by the Carboloy Department are as follows: FRANK G. MUSSEN, Alnico specialist in the Atlantic district (Massachusetts, Maine, Vermont, New Hampshire and upper New York State); J. M. STEVENSON, salesman with headquarters in Marcellus, N. Y.; T. E. ODELL, salesman in the southern Ohio territory, with headquarters in Cincinnati, the territory that Mr. Stevenson formerly represented.

DOW CHEMICAL Co., Midland, Mich., announces the promotion of the following members of its plastics department: DR. WILLIAM H. SCHUETTE, manager of the newly formed plastics production department; and MAX KEY, EARL L. COLLINS, and ALBERT T. MAASBERG, managers of saran, polystyrene and cellulose production, respectively. Other appointments made by the company are: JAMES V. WINKLER, formerly with the magnesium sales group in the Los Angeles, Calif., office, is now head of the magnesium sales department's technical service and development group; and R. D. SWEET is assigned to the magnesium sales staff of the Los Angeles office.

HARRY F. VICKERS, founder and president of Vickers, Inc., Detroit, Mich., subsidiary of the Sperry Corporation, New York City, was recently elected president of the parent company, succeeding THOMAS A. MORGAN, who has retired. KENNETH R. HERMAN, vice-president and general manager of Vickers, Inc., was elected vice-president of the Sperry Corporation. Both men will continue in their present capacities at Vickers, Inc.

GEORGE E. PRIFOLD has become head of LVT (Landing Vehicle, Tracked) Division of the Ingersoll Products Division of the Borg-Warner Corporation at Kalamazoo, Mich. Mr. Prifold will be responsible for engineering, procurement, production control, and manufacturing at the LVT plant.

RALPH HUBBART, president of the Allied Products Corporation, Detroit, Mich., has become chairman of the board, and FRANK H. BISHOP, executive vice-president, has been promoted to the presidency.

WILLIAM E. ATCHLEY was recently appointed general sales manager of the National Twist Drill & Tool Co., Rochester, Mich., and FREDERICK D. LAMB, was made assistant general sales manager.

CHESTER L. SHAW has joined the Detroit Broach Co., Detroit, Mich., in the capacity of works manager. Mr. Shaw was formerly with the Ross Gear & Tool Co., Lafayette, Indiana.

New York and New Jersey

E. F. MECHLIN, JR., has been appointed manager of the Washington, D. C., sales office of the Crucible Steel Co. of America, New York City. Mr. Mechlin was formerly with the National Production Authority. The company also announced the following appointments of stainless steel supervisors: F. J. McNiff, in the area including New York, Philadelphia, Baltimore, Syracuse, Buffalo and New Haven; H. J. Arnold, Cleveland district; and A. F. McClean, in Boston, Springfield, and Providence.

JOHN H. BIGGS will assume charge of the New York office of the Brown & Sharpe Mfg. Co., Providence, R. I., succeeding JOSEPH H. SKELTON, who has retired. Mr. Biggs was formerly located in the Philadelphia office of the company, and his position there will be filled by JOHN J. MCALEESE.

NILES C. BARTHOLOMEW, formerly assistant director of manufacturing of the Carborundum Co., Niagara Falls, N. Y., was recently appointed vice-president of the company's new subsidiary, the Carborundum Metals Co., Inc.

Niles C. Bartholomew, the vice-president of a new subsidiary of the Carborundum Co.

(This section continued on page 265)

Lester D. Chirgwin, newly elected president of the Consolidated Machine Tool Corporation

LESTER D. CHIRGWIN, vice-president of Farrel-Birmingham Co., Inc., Ansonia, Conn., has been elected president of Consolidated Machine Tool Corporation, Rochester, N. Y., a subsidiary acquired by Farrel-Birmingham last year. He succeeds ARTHUR H. INGLE, who will remain on the board of directors of both companies and continue in the capacity of corporation consultant.

E. M. KLINE is being made general manager of the Huntington, W. Va., Works of the International Nickel Co., Inc., New York City. Mr. Kline succeeds HERMAN M. BROWN, who is retiring. G. K. CROSBY will become assistant general manager of the Works, filling the position vacated by Mr. Kline. Also announced by the company are the following appointments: RANSOM COOPER, JR., manager of the nickel sales department; and H. D. TIETZ, manager of the Inco nickel alloys department.

EUGENE S. PAGE has been named special assistant to the executive vice-president of the American Machine and Foundry Co., New York City. Prior to this, Mr. Page directed purchasing activities for the Great Lakes Carbon Corporation, Chicago, Ill.

SIMON COLLIER, director of quality control for the Johns-Manville Corporation, New York City, was elected president of the American Society for Quality Control at the Society's annual convention held in Syracuse, N. Y.

OTTO HAJEK has joined Fritz Fischer, Inc., New York City, designer of heavy machinery, as manager of the department of special development.

JACQUES W. LOURIE, a mechanical engineer and staff member of Hydropress, Inc., New York City, for more than a decade, has been appointed director of foreign sales.

JOHN D. JUDGE has been appointed president of the Tube Reducing Corporation, Wallington, N. J., succeeding the late J. J. WHITE. Mr. Judge joined the company in 1948 in the capacity of executive vice-president.

ALBERT DORMAIER, JR., was recently made direct sales engineer in northern New Jersey, Metropolitan New York, and Long Island for Precision Metalsmiths, Inc., Cleveland, Ohio, manufacturer of investment castings.

Ohio

THE METAL CARBIDES CORPORATION, Youngstown, Ohio, is beginning the construction of a $1,000,000 plant on a seventeen-acre site located at Mathews Road and Southern Blvd., Boardman, Ohio. It is planned that the new plant will have a monthly capacity of approximately 25,000 pounds of tungsten carbide metal, tungsten alloy heavy metal, titanium, and other special alloys made from powdered metals.

JOHN E. HATHAWAY was recently made representative in the Ohio territory, with headquarters in Cleveland, for the Cushman Chuck Co., Hartford, Conn., manufacturer of power-operated chucks, air cylinders, etc. Mr. Hathaway succeeds WILLIAM C. GAW, who was recently appointed sales manager of the company.

WELLMAN BRONZE & ALUMINUM CO., Cleveland, Ohio, announces the following appointments: BENJAMIN E. WEIMER is to administer a clearing house for customers at the company's Cleveland office; EDWARD C. EIZEMBER, superintendent of the Peerless plant; and ROBERT A. THOMAS, superintendent of the Garfield plant.

WILLIAM A. SIPPRELL, JR., chairman of the board and president of the H. & B. American Machine Co., Pawtucket, R. I., has become president of the Cleveland Welding Co., Cleveland, Ohio, subsidiary of the American Machine & Foundry Co., New York City, succeeding HARRY W. KRANZ, who is retiring.

W. BRADFORD ABBOTT, vice-president in charge of sales for the Ohio Gear Co., Cleveland, Ohio, has announced his resignation effective June 30. Mr. Abbott had been with the company since 1934.

A. P. MCALLISTER, manager of the process equipment division of the Babcock & Wilcox Co., at Barberton, Ohio, has retired. Mr. McAllister was with the company thirty-two years.

Douglas O. Yoder who was recently elected president of the Yoder Co.

DOUGLAS O. YODER has been elected president of the Yoder Co., Cleveland, Ohio, to succeed JOHN O. LUCAS, who is retiring. Mr. Yoder has been with the company since 1935, except for a period of three years during World War II. In 1949, he became assistant to the president. Also announced was the retirement of FRANK R. SARGEANT, executive vice-president and treasurer of the company. Both Mr. Lucas and Mr. Sargeant will remain on the board of directors.

CHARLES C. REIFF has been appointed chief engineer of the Barberton Division, Barberton, Ohio, of the Rockwell Mfg. Co., Pittsburgh, Pa. Mr. Reiff was formerly project engineer of the lubrication department in Pittsburgh, a position that will now be filled by BERNARD LAST.

F. W. BOYE III has been elected chairman of the board of the Boyé & Emmes Machine Tool Co., Cincinnati, Ohio, manufacturer of heavy-duty engine lathes. GILBERT J. RUTENSCHROER has been appointed president and general manager.

TRUMAN E. LONGLEY CO., Cleveland, Ohio, has been appointed representative in northern Ohio for Carmet, the cemented carbide division in Detroit, Mich., of the ALLEGHENY LUDLUM STEEL CO., Pittsburgh, Pa.

HYDRAULIC EQUIPMENT CO., Cleveland, Ohio, announces that in the future the company will operate as Hydreco, a Division of the New York Air Brake Co., instead of as a subsidiary of that company.

PAUL VINSON has been named director of engineering and research, and BERNARD E. LOGSDON, assistant chief engineer, for the Sheldrick Mfg. Co., Upper Sandusky, Ohio.

Frank Heap was recently appointed district manager for the grinding fluid "Trim" manufactured by the Master Chemical Corporation, Toledo, Ohio. Mr. Heap's headquarters are at 1717 Section Road, Cincinnati, Ohio.

Harry C. Brainard has been appointed chief metallurgist for the Cleveland Chain & Mfg. Co., Cleveland, Ohio, and D. J. Owens has been made sales manager.

Pennsylvania

James H. Oakes, formerly sales manager for enclosed drives, has been appointed sales manager at the Philadelphia, Pa., plant of the Link-Belt Co., Chicago, Ill. Byron K. Hartman, who was assistant sales manager in Philadelphia, has become sales manager at the company's new Colmar Plant, Colmar, Pa. Also appointed to this plant was Stuart T. Penick, sales engineer, who will specialize in power plant coal handling equipment. The position of district manager at Moline, Ill., which Mr. Penick held, will be filled by George A. Most, Jr.

Truman B. Brown has been appointed assistant to the vice-president of sales of the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. At the time of his appointment Mr. Brown was district sales manager in Detroit, Mich. Ian R. Kiltie has succeeded Mr. Brown as district manager of sales in Detroit, and H. H. Lardin has become assistant manager there.

F. H. Allison, Jr., has been appointed to the newly created position of assistant vice-president in charge of metallurgy and roll sales for the Blaw-Knox Co., Pittsburgh, Pa. Dr. Allison comes to the company from the United Engineering & Foundry Co., where he was chief metallurgist for the last eight years.

Samson Sales Co., San Francisco, Calif., has been appointed representative for the Ajax Electric Co., Philadelphia, Pa., in Nevada and northern California. Also announced were the appointments of the following sales representatives: Richards-Conant, Denver, Colo.; and W. E. Hartley, Seattle, Wash.

D. G. Clark has become assistant general sales manager of Firth Sterling, Inc., Pittsburgh, Pa. Mr. Clark has been with the company since 1903, most recently having been steel sales manager. E. William Kalb has been appointed to the position vacated by Mr. Clark.

E. G. Brown, Jr., has been appointed sales representative by J. H. Williams & Co., Buffalo, N. Y., manufacturer of drop forgings. In his new capacity, Mr. Brown will assist J. J. McCann, Philadelphia, Pa., district manager.

Tom L. Parker has been made vice-president in charge of sales for the Columbia Steel & Shafting Co., Carnegie, Pa., producer of cold-finished steel bars and cold-drawn seamless steel tubing.

Richard V. D. Strong, formerly Chicago district manager, has been appointed chief engineer of the F. J. Stokes Machine Co., Philadelphia, Pa.

Paul Porterfield has joined the Method X Co., an affiliate of Firth Sterling, Inc., Pittsburgh, Pa., in the capacity of chief engineer.

Torbett Crocker has joined the Reese Machinery Co., Pittsburgh, Pa., machine tool and metal-working distributor.

H-B Instrument Co. will shortly occupy its newly acquired plant at American and Bristol Sts., Philadelphia 40, Pa.

Texas and Georgia

Standard Tool Co., Cleveland, Ohio, manufacturer of cutting tools, is erecting a building at 1621 Dragon St., Dallas, Tex., and is establishing a branch office there.

General Electric Co., Schenectady, N. Y., is building a new transformer manufacturing plant at Rome, Ga. It will be completed by the middle of 1953, according to plans.

Wisconsin and Minnesota

The Crusher and Process Machinery Divisions of the Nordberg Mfg. Co., Milwaukee, Wis., have established a district office in Duluth, Minn., with G. E. Jarpe as district manager. Previous to his transfer, Mr. Jarpe was district manager at Spokane Wash., for the company.

George C. Wilder, vice-president and assistant general manager, has been appointed president of the Macwhyte Co., Kenosha, Wis. Mr. Wilder was also appointed a director to fill the unexpired term of the late Jessel S. Whyte, who had been president of the company at the time of his death.

A. E. Harrant has been promoted from the position of office manager to executive vice-president of the Miller Electric Mfg. Co., Appleton, Wis., manufacturer of electric welding equipment. A. C. Mulder has been made vice-president in charge of production.

Nichol Machinery Co., Inc., Milwaukee, Wis., has been appointed distributor for a line of horizontal boring, drilling, and milling machines and accessories manufactured by the Ohio Machine Tool Co., Kenton, Ohio.

Coming Events

September 8-10 — Third National Standardization Conference sponsored by the American Standards Association in Chicago, Ill. Headquarters, Museum of Science and Industry. Further information can be obtained by writing to the Association at 70 E. 45th St., New York 17, N. Y.

October 20 - 24 — National Metal Exposition and Congress at the Philadelphia Convention Hall, Philadelphia, Pa. Secretary, W. H. Eisenman, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

November 5-7 — Sixteenth Annual Time and Motion Study and Management Clinic sponsored by the Industrial Management Society at the Sheraton Hotel, Chicago, Ill. Further information can be obtained by addressing the Society, 35 E. Wacker Drive, Chicago 1, Ill.

November 19—Thirty-fourth annual meeting of the American Standards Association at the Waldorf-Astoria in New York. Headquarters of Association, 70 E. 45th St., New York, N. Y.

November 20-21—Seventh Mid-West Conference of the American Society for Quality Control at the Claypool Hotel, Indianapolis, Ind. For further information, address Dale A. Cue, 5565 Brookville Road, Indianapolis, Ind.

December 1-6—Twentieth National Exposition of Power and Mechanical Engineering at the Grand Central Palace, New York City, under the auspices of the American Society of Mechanical Engineers. Executive assistant secretary, Ernest Hartford, 29 West 39th St., New York 18, N. Y.

* * *

Perspective graphs have been devised that permit scaling directly from an engineering drawing for making an accurate perspective view. Based on the principles of visual perception, these graphs are entirely free from distortion. By their use, perspective projection is said to be as simple and as rapid as isometric projection with the added advantage of depicting the subject to be drawn as the eye actually sees it. These graphs are available from Tech-Art Graphs, 315 S. 15th St., Philadelphia 2, Pa.

New Books and Publications

MacRae's Blue Book. 4315 pages, 8 1/2 by 11 inches. Published by MacRae's Blue Book Co., 18 E. Huron St., Chicago 11, Ill. Price in the United States and Canada, $15 F.O.B. Chicago.

This buying guide, and annual directory of American industry, now in its fifty-ninth edition, covers all the manufactured products in the United States. There are four sections in the book. The first comprises an alphabetical list of the names and addresses of all manufacturers of the various products, including, in many cases, names of officers and local distributors. This section is also supplied in a separate paper-bound book—a special feature aimed to permit dual use of the data in a busy office, for instance.

The second and main part of the book is the classified material section containing 3400 pages and listing all manufacturers of a given product under the name of the product. These classifications are thoroughly subdivided, so that it is easy to locate the particular type of equipment desired. The third section of the directory consists of chemical classifications; chemicals and related materials; chemical equipment and supplies; and services. The last section consists of an alphabetical list of the trade names of the products included in the classified material section.

This book will prove useful to sales departments, purchasing agents, and all those who need to make up a list of industrial concerns or products for any purpose.

Warner & Swasey Instruction Manual. 234 pages, 7 by 10 inches. Published by the Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio. Price, $5 ($2.50 to interested persons in the metal-working field).

Warner & Swasey five-spindle bar and chucking automatic machines are comprehensively treated in this instruction manual, whose objective is to familiarize the machine operator, set-up man, maintenance man, production supervisor, and manager with the performance of these machines. The book consists of these sections: Getting Ready to Operate the Bar and Chucking Automatics; Machine Constructions Common to Bar and Chucking Automatics; Additional Construction Features of Bar and Chucking Automatics; Machine Attachments; Tooling; and Charts and Tables. Each section is individually indexed. Thus, in Part I, Getting Ready to Operate, the subjects covered may readily be referred to—Installing the Machine, Installing the Bar Stock Carrier, Lubrication System, Cutting Fluid System, and Starting up the Machine. Diagrams, photographs, charts, and tables all aid in instructing the reader on the working of five-spindle automatics.

ASTM Standards on Copper and Copper Alloys. 498 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $4.75 (paper bound); $5.40 (cloth bound).

This latest edition brings together all of the ASTM standards pertaining to copper and copper-base alloy products which were developed by technical committees of the Society.

Specifications and test methods contained in the book cover plate, sheet, rolled bar, and strip; rod, bar, and shapes; pipe and tubes; wire; sand- and die-castings; arc-welding electrodes and brazing solder; standard nominal diameters and cross-sectional areas of American Wire Gage sizes of solid round wires used as electrical conductors; stranded conductors and other electrical usages of copper; and such non-ferrous metals as slab zinc, pig lead, nickel, phosphor, silicon, and electrolytic cathode copper. Also included are test methods for copper and copper alloys covering expansion, mercurous nitrate, resistivity, tension, micrographs, hardness, sampling, and grain size evaluations.

Handbook of Engineering Fundamentals (Second Edition). Edited by Ovid W. Eshbach. 1118 pages, 5 1/2 by 8 1/4 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $10.00.

This handbook embodies in a single volume those laws and theories of science that are basic to engineering practice. It is essentially a summary of the principles of mathematics, physics, and chemistry, the properties and uses of engineering materials, the mechanics of solids and fluids, and the commonly used mathematical and physical tables, to which has been added a discussion of contractual relations.

The thirteen sections of the handbook represent the work of thirty-nine contributors, each a recognized authority. For the Second Edition, the sections on mathematics, fluid mechanics, electricity and magnetism, engineering materials, and engineering law have been completely revised. Other sections have been thoroughly reviewed, and where necessary have been changed or augmented. Greater emphasis has been given to the more widely used MKS (meter-kilogram-second) and rationalized MKS systems of units.

Practical Metallurgy for Engineers. 599 pages, 5 3/4 by 8 3/4 inches. Published by E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Price, $3.50.

This is the fifth edition of a book dealing with the practical side of heat-treatment and metal-working, brought up to date with the inclusion of the latest standards and practices followed in the metal industry. E. F. Houghton & Co., which has had extensive experience over the past half century along heat-treating lines, has endeavored in this book to set forth the continuous advancements in the industry, and to cover future probabilities of the new metals, new alloying elements, and new types of heat-treatment.

Following are the chapter headings: Physics and Chemistry of Metallurgy; Metals and Their Ores; Fuels; Refractories; Non-Ferrous Metals; Iron Ores; Manufacture of Iron and Steel; Mechanical Treatment; Temperature Measurement; Heat-Treatment of Steels; Quenching; Grain Size and Hardenability; Metallography; Testing and Inspection; Heat-Treating Furnaces; Liquid Salt Baths; Other Methods of Heating; Carburizing; Other Surface Hardening Methods; Heat-Treatment of Non-Ferrous Alloys; Cleaning Procedure and Control; and Steel Classification and Specifications.

Machine Shop Technology. By C. A. Felker. 491 pages, 5 3/4 by 8 3/4 inches, 529 illustrations. Published by the Bruce Publishing Co., 400 N. Broadway, Milwaukee 1, Wis. Price, $4.80.

The material in this book has been assembled for use in vocational schools, vocational departments of general high schools, and apprentice programs. Organization of the book is around the more common shop skills, operations, and related trade information, technology, science, mathematics, and interpretation of blueprints. For example, the cutting tools used on the milling machine and the lathe are considered as part of the discussion of milling and lathe work, rather than as separate items.

Problems in mathematics are functional, and are based on the actual calculations involved in acquiring the skill for the particular operation. Illustrative problems are explained and solved, and additional problems are included for practice.

Amortization of Defense Facilities. 108 pages, 6 by 9 inches. Published by the Machinery and Allied Products Institute, 120 S. LaSalle St., Chicago 3, Ill. Price, $1.00.

This is a research study of the subject of accelerated amortization of privately owned defense facilities. The study compares government and

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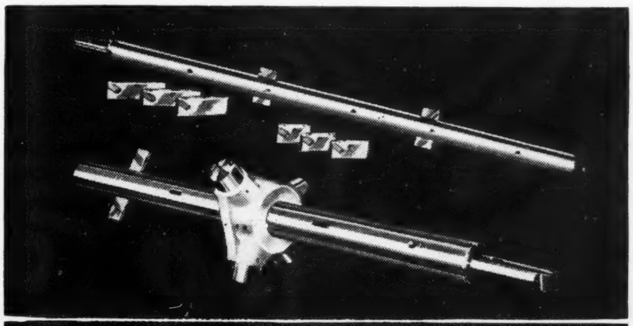
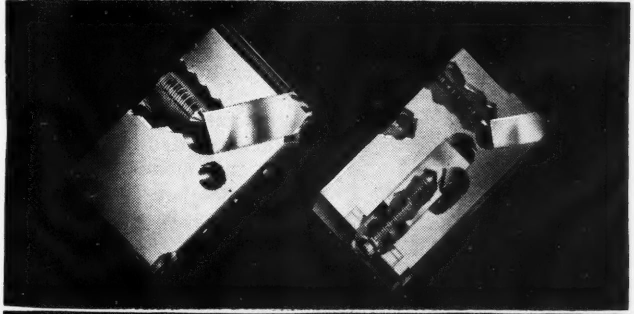


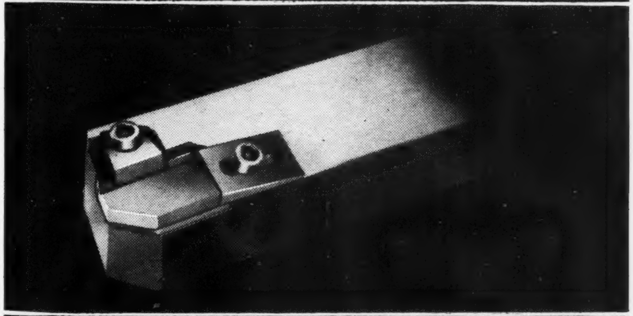
To meet individual needs, Davis has a wide range of plain and block type line bars for specific applications. Case hardened bars are furnished when cutting loads are heavy and wear resistant qualities are needed for high production. Cutter blocks are quickly inserted in tool slots and locked in accurate position with a taper lock screw.

Also available for mounting on Davis line boring bars are other micrometer adjustable cutter blocks and boring heads capable of obtaining bores up to 50" diameter.

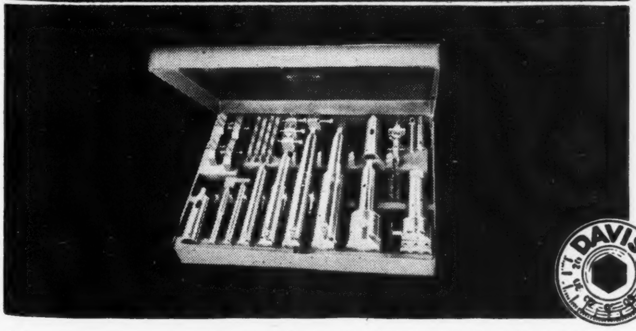


Davis regular single and two-cutter adjustable block type cutters are ideal for general purpose boring where rigidity and a wide range of cutter adjustments are the main requisites. Boring range ¾" to 17".

Multiple cutter types, although special in design, are in most cases interchangeable with regular blocks, and can be furnished with two or more sets of cutters for boring, counterboring and facing. These are built to suit requirements.



Sturdy Davis "clamped-on" tipped carbide cutters and massive holders make it practical to use maximum planer feeds with minimum strain upon the tip. Holders are made in either right or left hand and will accommodate different style tips which means less holders are required.



Davis stub boring tools speed up boring operations on vertical and horizontal boring machines. They are available in sets consisting of precision made stub boring bars that are accurate to .0001" fine adjustment. Range from ½" to 7" diameter.

DAVIS BORING TOOL DIVISION

GIDDINGS & LEWIS MACHINE TOOL COMPANY • Fond du Lac, Wis.

Manufacturers of: TABLE, FLOOR AND PLANER TYPE HORIZONTAL BORING, DRILLING AND MILLING MACHINES • VERTICAL BORING AND TURNING MILLS • DOUBLE HOUSING AND OPEN SIDE PLANERS AND PLANER TYPE MILLING MACHINES • COMPLETE TOOLING SERVICE

private ownership of defense facilities, and gives the history and legislation behind the amortization programs in World Wars I and II and in the present emergency. It also considers the problems of incentive, use value, cost allowance, the question of subsidiary, and the tax benefits of accelerated amortization.

HEIGHT - COMBINATION TABLES AND HEAT - EXPANSION CALCULATOR. Published by the DoAll Co., Des Plaines, Ill. Price, $2.95.

By referring to the tables in this book it is possible without further calculation to select the gage-block combination for any dimension from 0.0001 inch to 1.0000 inch, in 0.0001-inch steps. The heat-expansion calculator gives the correction to be made for differences in the coefficient of expansion between gage-blocks and parts, other than steel, that are being checked. The book also includes information on the care of gage-blocks, instructions for the use of wear blocks, and other helpful advice.

HOW TO RUN A METAL-WORKING SHAPER. 32 pages, 65 illustrations. Published by the South Bend Lathe Works, South Bend 22, Ind. Price, 25 cents.

Carbide-Tipped Metal Saw Solves Precision Slotting Problem

The machining of ten slots in the large alloy iron rotor shown in the accompanying illustration presented rather a troublesome problem until solved by the set-up described, in which a carbide-tipped metal-slitting saw is employed. The slots in the rotor are 5 3/4 inches deep by 52 inches long and must be held to a width of 0.140 inch within plus or minus 0.002 inch. Ten slots of the same length, but held to a width of 0.437 inch within plus or minus 0.002 inch are also required to be machined in the rotor.

In order to hold the slots to size within the required limits, the machining operations were originally performed on a planer, using a carbide-tipped gooseneck tool. With this set-up, however, it required seventy-five hours to machine each slot to size and produce the necessary finish. Smoothness of the slot walls is essential since the slots have to be a close sliding fit for fins or rotor blades which depend on centrifugal force to keep them in contact with the rotor housing.

In an effort to eliminate the discouraging delays caused by the necessity for frequent resharpening of the planer tool, the work was switched to the boring machine shown in the illustration and a metal-slitting saw with carbide-tipped teeth was used to machine the slots. Employing a Woodsman saw blade manufactured by the North American Products Co., Milwaukee, Wis., it was possible to complete all ten slots in only two and one-half hours—including set-up time on the job. The Woodsman saw blade produced a better quality of work and held the slots accurately to size during its entire life, no change in slot width resulting from regrinding the teeth.

Cutting deep slots to close tolerances in a large rotor employing a boring mill equipped with a saw blade having carbide-tipped teeth

Second European Machine Tool Exhibition

The Second European Machine Tool Exhibition, sponsored by the European Committee for the Co-operation of Machine Tool Industries, will be held in Hanover, Germany, from September 14 to 23, inclusive. The Committee is sponsored by Belgium, France, Germany, Holland, Italy, Sweden, and Switzerland. There will be approximately 750 exhibitors from thirteen different countries, who will display their products in eight halls having a total space of 700,000 square feet. All exhibits will be classified according to category and not by nationality of the manufacturer, so as to enable easy comparison of the machines available in the various classifications. Five halls will be devoted to metal-cutting machines.

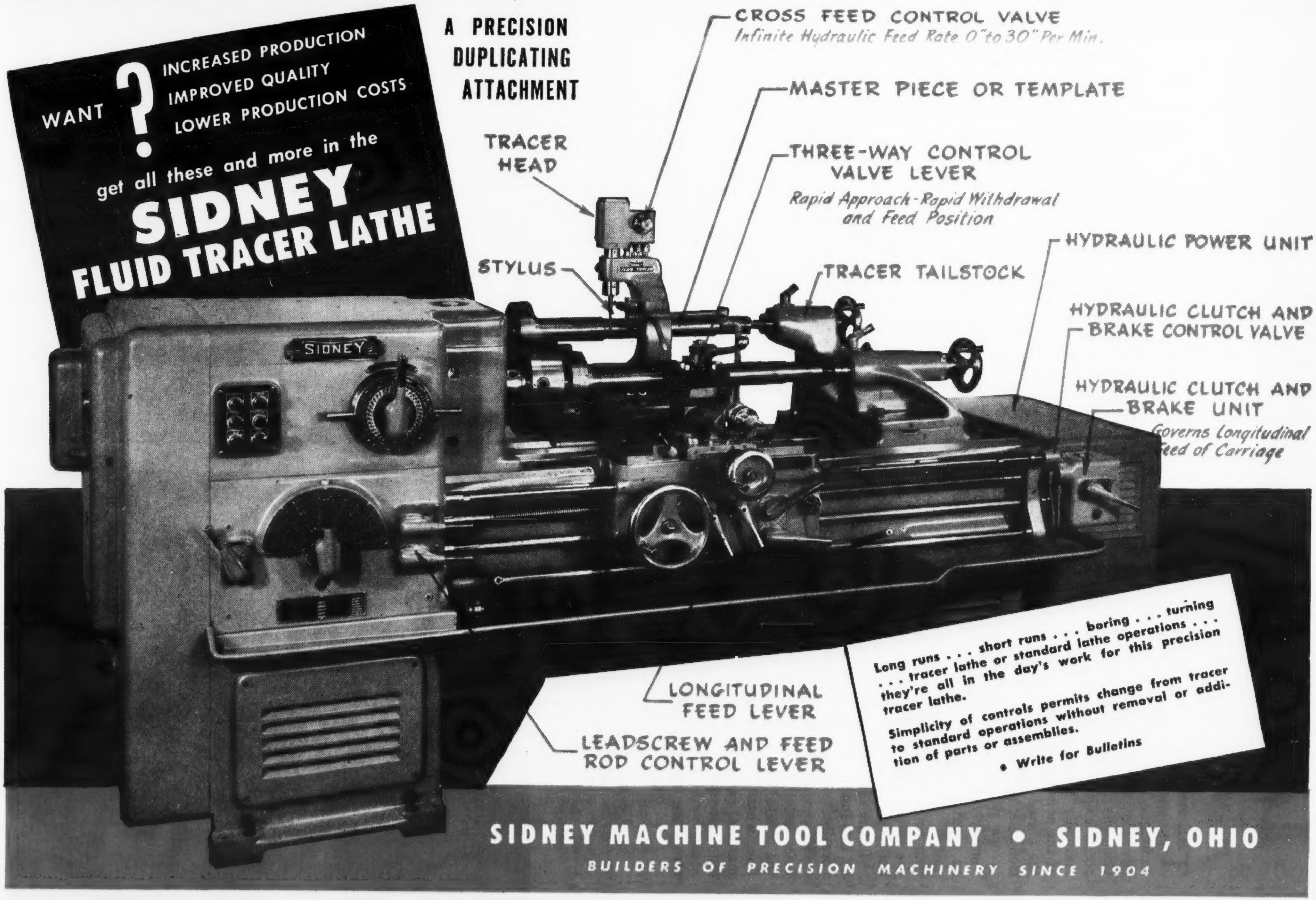
* * *

Seeing Gages in Use

"Gaging for Profit" is a film which runs for thirty-eight minutes, showing practically all known modern methods of gaging for the control of dimensional accuracy. The Federal Products Corporation produced this film, and actually covered over 4000 miles in obtaining views of typical gages in use in customers' plants. Briefly demonstrated is the value of indicating gages in statistical quality control. The film is available to industrial concerns on loan, without charge, by writing to the Federal Products Corporation, 1144 Eddy St., Providence 1, R. I.

* * *

The twenty - fourth "More Power to America" program of the General Electric Co., Schenectady, N. Y., is built around the theme of increasing industrial productivity through a plan called "Progressive Mechanization"—from replacement of hand operations by simple machines up through fully automatic continuous - process systems. A kit is available for industrial firms, electric utility companies, and trade associations containing a 16-millimeter sound-color film, "Motors in Industry," a manual, and a survey form.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Long runs . . . short runs . . . boring . . . turning . . . tracer lathe or standard lathe operations . . . they're all in the day's work for this precision tracer lathe.
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Radioisotopes Control Thickness of Coated Abrasives

THE manufacture of coated abrasives is controlled by a novel technique at the Coated Products Division of The Carborundum Company, Niagara Falls, N. Y. It is possible by nuclear gaging to automatically maintain the thickness of the adhesive and the density of the abrasive right on the production line, and to an accuracy within one per cent of specifications. Formerly, production control was on a cut-and-try basis, which required stopping machinery, cutting out an edge sample, checking the sample, then readjusting rolls and feeds.

In the new technique, developed by the Industrial Nucleonics Corporation, Columbus, Ohio, five radioisotope-actuated gages have been installed on each machine in the coated abrasive production line, where the thickness of the material can be measured as it is being processed. In each gage a sealed capsule of radioactive strontium emits beta rays. As the material moves past the aperture between the sources and the detector unit (a special type of ionization chamber), the amount of radiation passing through the material varies according to the density of the material. The beta rays that get through to the detector unit ionize a gas and thus create a voltage which provides a recording and controlling signal. Since the gage is calibrated, variations in beta ray transmission cause changes in the signal that vary directly with the change in weight per unit area.

Gage 1 measures backing weight. This backing is usually paper, cloth, or fiber. Variation in unit weight of the backing affects future coating operations, such as adhesive roll setting. Thus, Gage 1 furnishes a base measurement. Gage 2 measures the backing weight plus the weight of the adhesive coat. Gage 3 measures the backing weight, plus the weight of the adhesive coat, plus the weight of the abrasive. Gage 4 measures the total weight after the preliminary cure and before the final adhesive application. Gage 5 measures the finished weight after the final adhesive application.

Signals from the gages are translated into a trace on pen recorders. Superimposing the trace signal from Gage 1 and the signal from Gage 2 (each a different color) on one recorder provides a visual comparison of machine coating. The two signals from Gage 2 and Gage 3 superimposed on a second recorder show immediately any deviation from specification. When the two traces overlap, the material is being made properly.

With this gaging method, it is possible to produce on a practical manufacturing basis uniform coatings despite lot-to-lot variations in backing materials, and despite the slightest variation in flow of adhesive or abrasive onto the moving web, or variation in machine speed. In conventional manufacture, such errors tend to accumulate and might cause rejection of the finished product.

Second nuclear gage in the production line automatically measuring the weight of the backing plus the weight of the adhesive as the material moves through the abrasive coating machine. Abrasive material (background) streams onto adhesive-coated backing.

Recorders that are synchronized with the speed of the material passing through the abrasive coating machine give continuous indication of whether specifications are being met. Records made this way can be kept permanently for reordering or duplication.